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SCIENTIFIC THOUGHT IN EUROPE.

A History of European Thought in the Nineteenth Century. By John Theodore Merz. Vol. i., pp. xiv + 458; vol. ii., pp. xiv + 807. (Edinburgh and London: William Blackwood and Sons, 1903–4.)

A NEWSPAPER review of this book has come into our possession, which gives the impression that its most prominent feature is the treatment of biological questions such as the Darwinian theory. Doubtless the reviewer was a biologist. His remark that "the book is not a very easy one to read" is, however, very true.

Now to the present writer the feature which appears most noteworthy is the author's intimate knowledge of *mathematics*, as revealed in his masterly expositions of the development of all branches of mathematical thought during the last century. Probably an exhaustive account of this work could only be given by a number of different reviews written by specialists in different subjects, and such reviews would be so different that it would be difficult to realise that they all referred to the same book. The course we propose to follow is to give a general outline of the scope and subject-matter of the book, to scrutinise a little more closely the portions devoted to mathematics and mathematical physics, and to subject such branches as thermodynamics and kinetic theory to a still closer scrutiny.

At the outset (pp. 24–27), Dr. Merz is confronted with the difficulty that he can find no precise equivalent in French or German for our English word *thought*; for instance, he says:—

"No other language has a word so comprehensive, denoting at once the process and the result, the parts and the ideal whole of what is felt and meant. . . ."

"And yet I think I am right in saying that the conception of thought in the sense in which I am using it is truly an outcome of international, not of specifically English progress, and belongs mainly to the period of which I am treating. . . ."

What thought precisely is the author considers impossible to define, but it is only thought which renders the phenomena of nature intelligible, as he says (p. 2):—

"That which has made facts and events capable of being chronicled and reviewed, that which underlies and connects them, that which must be reproduced by the historian who unfolds them to us is the hidden element of thought."

It is the object of these volumes, as the author remarks on page 13,

". . . . . to rescue from oblivion that which appears to me to be our secret property; in the last and dying hour of a remarkable age to throw the light upon the fading outlines of its mental life; to try to trace them, and with the aid of all possible information gained from the written testimonies or the records of others to work them into a coherent picture, which may give those who follow some idea of the peculiar manner in which our age looked upon the world and life, how it intellectualised and spiritualised them."

On p. 34 he says:—

"A history of this thought will be a definition of thought itself."

In order to limit the scope of the inquiry, Dr. Merz confines his attention to European thought, and of this, again, he only selects the central portion, the thought embodied in French, German, and English literature. Accordingly the first three chapters deal with the scentific spirit in France, Germany, and England respectively. This order of arrangement is a fitting one, and well brings out all that has been said by various writers about "England's neglect of science." Thus (p. 75):—

"Compared with Germany in philosophy and with France in science, England during the early part of the century appears remarkably unproductive. English science and English philosophy had flourished in the seventeenth and eighteenth centuries and leavened the whole of European thought, but in the beginning of our period we find neither represented by any great schools. The great discoveries in science belonged to individual names who frequently stood isolated; the organisation and protection which science could boast of in France was then unknown in England; into popular thought it had hardly entered as an element at all."

It is to France that we must turn in order to find what might be described as a *national* scientific spirit, and this spirit was very largely the outcome of the foundation of the Paris Academy of Sciences.

"Whilst the Royal Society of London only received a charter, and existed by the entrance payments and contributions of its own members, augmented by private donations; the Paris Academy had as far back as 1671 received the funds with which to commence its labours in connection with the survey of the kingdom and its extensive dependencies." . . . "It was almost exclusively by these observations that the data were found with which to substantiate Newton's mathematical reasoning; in his own country that fruitful cooperation which can only be secured by an academic organisation and the endowment of research was wanting" (p. 99). "In two important departments—the popularisation and the teaching of science—France for a long period led the way. A general interest was thus created in the proceedings and debates of the Academy. . . . .".

In the present connection are cited Laplace's "Mécanique Celeste," and the development of the analytical methods rendered possible by Leibnitz's invention of the calculus, about which we are told (p. 101),

"No learned body did more than the Paris Academicians to perfect (with purely scientific interest) this new calculus, which in the course of the eighteenth century had in the hands of Lagrange been adapted to all the purposes and problems contained or suggested in Newton's Principia."

As another illustration we take the popular interest which centred round Laplace's discovery of the calculus of probabilities (pp. 120 *et seq*).

Passing on to Germany we find national interest converging towards another equally important centre, namely, the university system, which is unique of its kind. This system was perfected in the eighteenth, and fully developed at the beginning of the present century. It is essentially a training school of research

and its ideal is expressed in the word *Wissenschaft*. This word, Dr. Merz considers, "cannot be defined by any single word of the English language."

"In fact, the German word for science has a much wider meaning than *science* has in French or English, it applies alike to all the studies which are cultivated under the roof of an 'alma mater'; it is an idea specially evolved out of the German university system, where theology, jurisprudence, medicine and the special philosophical studies are all held to be treated 'scientifically' and to form together the universal, all-embracing edifice of human knowledge" (p. 170).

It was not, however, until the second quarter of the century that the scientific spirit had entered the universities.

"During these twenty-five years Gauss lived and soared in solitary height—a name only to the German student as Euler had been before him." "The man to whom Germany owes its first great school of mathematics was Jacobi" (pp. 184–5).

"German science was essentially cosmopolitan, and the absence of a central body like the Paris Academy, led to an important result, the publication of a large number of periodicals devoted to special branches of science."

Turning to Great Britain the author says (p. 225):—

"Considering that the great scientific institutions of the Continent—the Paris Institute, the scientific and medical schools in Paris and the German universities—have done so much for the furtherance of science and the diffusion of the scientific spirit, it is natural that we should ask, What have similar institutions done in this country?"

A perusal of this chapter leads to the general conclusion that a "national" scientific spirit has never existed in our country. The records of the great discoveries made in Britain during the half-century ending 1825 (given in a footnote on p. 229) show that in that period hardly a year passed without some great scientific discovery being made by an Englishman, and fully justify the statement that

"England had during the early part of the century in all but the purely mathematical sciences a greater array of scientific names of the first order than Germany, and nearly as great an army as France."

And yet we find the works of these writers quite unknown in their own country, and in many cases only rescued from oblivion by falling into the hands of the Continental schools of science. We have only to instance Dr. Merz's references to the difficulties encountered by Young, Green, Babbage, Boole, Dalton, Faraday, and a host of others, and then to refer to foreign opinions on English science, as expressed by Cuvier and Prof. Moll, and quoted (pp. 235–7), as evidence of the high estimation in which British scientific work was held on the Continent. The lack of stimulus to scientific research, the absence of higher mathematical studies, were peculiarly noticeable in the two older universities, where traces of the same spirit survive to this day in spite of the internationalising influences which have played such an important part in recent scientific work. If Britain played a prominent part in the origination of the metric system, and if Continental nations base their zone system of time on the meridian of Greenwich, no better evidence of the general *national* apathy to science could be adduced than the fact that Britain is one of the few European States which have not yet universally adopted either of these systems.

The last two chapters of vol. i. are devoted to "The Astronomical View of Nature" and "The Atomic View of Nature," while chapters vi. to xii. in vol. ii. deal with the "kinetic or mechanical," the "physical," the "morphological," the "genetic," the "vitalistic," the "psycho-physical," and the "statistical" views of nature. These chapters refer more especially to the second half of the present century, and it is in them that we feel ourselves compelled to single out a few selected points rather than attempt to cover the whole range of subject-matter.

It is well known that many of our leading scientific ideas can be traced back to very ancient sources; as instances, Dr. Merz refers to the law of gravitation and the atomic theory as known to the Greeks and Romans, the kinetic theory as suggested by Heraclitus, the vortex atom theory as forestalled by Descartes and Malebranche (pp. 312–4). In passing judgment on these prior claims, Dr. Merz very rightly remarks:—

"It is the scientific method, the exact statement, which was wanting, and which raises the vague guesses of the philosophical or the dreams of the poetic mind to the rank of definite canons of thought, capable of precise expression, of mathematical analysis and of exact verification." "In every case the awakening touch has been the mathematical spirit, the attempt to count, to measure, or to calculate."

Those who flood our breakfast tables with "new" theories of the ether or designs of flying machines only constructed on paper will do well to bear these remarks in mind.

Let us now examine how Dr. Merz treats the second law and the ideas of temperature and entropy. In commenting on the work of Lord Kelvin and Clausius, he says (p. 128):—

"The result was the doctrine of the 'conservation of energy'—not of heat as Carnot had it—and the embodiment of the two correct ideas contained independently in Carnot's and Joule's work in the two well-known laws of thermodynamics—viz. the conservation, equivalence and convertibility of energy as expressed in the first law and the doctrine of the availability of energy as expressed in the second law."

In speaking of entropy (p. 169) he is no less definite in associating that conception with unavailable energy, and he only falls into a pitfall on p. 594, where he speaks of "entropy (or energy which is hidden away)" as if the two were identical and did not differ by a temperature-factor. But the footnote on p. 189 of Maxwell's "Heat," seventh edition, shows that in this he has erred in good company. In the footnote on p. 315, in discussing the absolute scale of temperature, he is more unfortunate. The scale "in which every one degree had the same dynamical value" was not the *present* absolute scale (which approximates fairly closely to the gas scale), but Lord Kelvin's *first* absolute scale, published in 1848, in which the absolute zero is not $-273°$, but minus infinity.

Of the application of statistical methods to the kinetic theory we can speak equally well in regard to the completeness with which the author has traversed

the literature of the subject. We do not find any reference to the underlying *assumption* which has up to the present been unearthed in every attempt to treat the problem mathematically. But this is hardly a point on which anyone but a specialist could be expected to light, and the majority of specialists make the assumption without knowing it (*pace* Burbury's criticisms).

The last chapter but one deals with the development of mathematical thought. We have selected for special examination the portions dealing with Cantor's researches on the transfinite and the continuum, and we find the subject treated in such a way as to present a clear and definite picture to one who has not specialised in this difficult branch of mathematical thought. The last chapter contains a retrospect and prospect.

We must not omit to mention what is, perhaps, as important a feature as any, namely, the footnotes, which occupy a considerable proportion of the whole book, and constitute a kind of historic encyclopædia.

We do not believe in filling reviews with lists of misprints, but the "Racket" (index, p. 800) may perhaps better describe Stephenson's locomotive than its correctly spelt name. A more serious defect is that these two large and bulky volumes have been issued with the pages uncut, and readers have to waste much time in doing what is the proper work of the guillotine before they can begin the book. This want of thought on the part of the publisher (on his own head be it—*i.e.*, the guillotine) constitutes a serious obstacle to the attempts made by scientific workers of the present day in endeavouring to cope with the ever-increasing mass of literature that accumulates before them.

G. H. BRYAN.

THE PROBLEMS OF VARIATION.

Variation in Animals and Plants. By H. M. Vernon, M.D. The International Scientific Series. Pp. ix+415. (London: Kegan Paul and Co., Ltd., 1903.) Price 5*s*.

THIS little book meets a real want. The frequent discussions of recent years upon the problems of evolution have been followed with much interest by an increasing number of readers and listeners, with the desire but often the inability to understand. A very large amount of interest and stimulus has been excited by such questions as acquired characters and their transmission or non-transmission by heredity, the continuity of the germ-plasm, physiological selection, continuous or discontinuous evolution, De Vries's experiments and views on mutation, the Mendelian hypothesis as opposed to that of Galton and the bearing of the great array of facts, the fruits of observation and experiment conducted by those who take opposite sides in the controversy. The present writer has often been surprised at the keenness of the interest which can coexist with an almost complete lack of knowledge of the essential details, and he feels that the present work provides precisely the information that is required—a clear, accurate, and dispassionate statement, not too long or too detailed, of researches and reasoning upon problems connected with variation.

The notable success of Section D during the late meeting of the British Association at Cambridge provides an excellent illustration of the wide and deep interest excited, at the present moment, by the last of the subjects mentioned above, and was in itself in some measure an answer to the complaint in the presidential address that insufficient attention was paid to the re-discovered discoveries of Mendel. The subject was new to probably a large proportion of the audience: those among them who had taken the opportunity of reading the fourth and fifth chapters (on blastogenic variation) of this work must have felt that they were thoroughly prepared to follow the discussion in all its detail.

The book is divided into three parts, of which the first, dealing with the *facts of variation*, contains three chapters, on the measurement of variation, dimorphism and discontinuous variation, and correlated variation respectively; the second, the *causes of variation*, includes two chapters on blastogenic variations, one on certain laws of variation, and four respectively treating of the effects of temperature and light, moisture and salinity, food and products of metabolism, and conditions of life in general; the third, *variation in its relation to evolution*, is considered in chapters on the action of natural selection on variation, and on adaptive variations.

The author wisely uses the word "hybridisation" very prominently in his account of Mendel's researches and conclusions. In the comparison between the Galtonian and Mendelian views of heredity an important difference is sometimes lost sight of—the present writer does not remember hearing it expressly mentioned, although it was certainly implied, at Cambridge. The former view is, at any rate chiefly, built upon the results of interbreeding between individuals separated by ordinary differences, the latter upon interbreeding between individuals separated by differences comparatively large. "Ordinary" differences are the points of distinction—generally small, mainly differences of degree—by which we discriminate between the individuals of a species forming a single compact mass, or if the species be broken up into two or more masses—then between the individuals within each of them. The larger differences alluded to are the points of distinction—generally large, frequently differences of kind—between the individuals of one mass ("species," "race," or "breed") and those of another, or between the ordinary individuals of a mass and those sudden large departures from its type which are apt to appear spontaneously in its midst. Even when breeds or races are distinguished by a test apparently so superficial and unimportant as colour, we are probably often confronted by the mere outward sign of inward and important distinction.

If the Mendelian view should hereafter be established beyond the possibility of doubt, there will still remain the interesting question of the part it has played in evolution. This is very largely the attempt to decide whether Darwin's earlier or later views were correct, whether evolution proceeds from the selection of large variations, "as when man selects," or from the selection of ordinary individual differences as

defined above. The question cannot be discussed on the present occasion, but it is well to bear in mind that however completely the *causes* of evolution in the past may evade our attempts at demonstrative proof, the *history* of evolution is a subject which can be brought to the test. For many years it has seemed to the writer that palæontology can settle decisively whether evolution has been continuous or discontinuous. Those who desire to bring conclusive evidence to bear upon this important controversy would do well to follow the example of Prof. W. B. Scott, of Princeton, who told us at Cambridge that he was "just crazy" over the fossil mammals of Patagonia.

In the last chapter, on adaptive variations, the author would have done well to place in the forefront the warning that a superficially apparent example "of direct adaptation to surroundings in the ordinary acceptation of the term . . . may be the calling up, in response to one of two stimuli, of one of two groups of characters long since acquired by the plant protoplasm." The principle contained in these words should be prominently before the mind of the naturalist who attempts to investigate the response of an organism to its environment. He should remember that the species which he investigates are "heirs of all the ages," thoroughly inured to experimental research, past masters in the art of meeting by adaptive response the infinite variety of stimulus provided by the environment. If he remember this he will always be on his guard against a too hasty interpretation based upon the fundamental properties of protoplasm.

The discussion of the question, are acquired characters inherited? (pp. 351 *et seq.*) is a particularly interesting and suggestive introduction to the subject. A few well chosen examples of the evidence chiefly appealed to in support of such transmission are followed by a brief but well balanced discussion. The author supports the conclusion that the soma, and through the soma the environment, exert a chemical influence upon the germ-cells, and he makes effective use of the "internal secretions" which have marked an epoch in physiological research.

Several examples, generally believed to supply evidence of the "cumulative action of conditions of life" (pp. 352 *et seq.*), would be more satisfactory and convincing if they were re-investigated as a piece of special research. Too often they bear the impress of an off-hand opinion without any secure foundation upon specially directed inquiry. Thus, in the transport of adult sheep or dogs to a different climate, it may be expected that less change will be manifest in the hairy covering of the parent than in that of the offspring which has been born and passed the whole of its life in the new conditions. Thus the appearance, but by no means necessarily the reality, of an accumulated effect may be produced. In order to test the hypothesis of accumulation, it would be necessary to neglect the generation which has been subjected to two very different environments and to determine quantitatively with all possible accuracy the characters of those which follow. The often repeated statements about the telegonic effect of mating "Lord Moreton's mare" with a male quagga, when compared with the results of Prof. Cossar Ewart's researches, prepare us for the belief that many a general impression which has been produced as evidence will collapse when it has become the subject of searching and critical investigation.

In the preface the author speaks with some diffidence of the prominence given to his own researches. Investigations such as those into the effect upon offspring of the relative freshness or staleness of the parental germ-cells would, in any circumstances, be an unfortunate omission from a book on variation. They are, moreover, described in the publications of scientific societies not always freely accessible to the general reader. For another reason also the book would have suffered if these researches had been treated less fully. When the author of a general work is not altogether wanting in the sense of fitness and proportion, the account of his own contributions to science will probably be the salt of his book. These subjects stirred his own enthusiasm for research, and in writing of them he is likely to stir the enthusiasm of others.

E. B. P.

MATHEMATICAL THEORY OF ECLIPSES.

The Mathematical Theory of Eclipses, according to Chauvenet's Transformation of Bessel's Method. Explained and illustrated by Roberdeau Buchanan, S.B. Pp. x+247. (Philadelphia and London: J. B. Lippincott Co., 1904.) Price 31*s.* net.

WHEN a practical man devotes himself to the task of explaining to others the difficulties of any specialised subject on which he has been engaged for many years, the result is likely to be satisfactory. There is always the chance that the prolonged study of one particular subject has had the effect of unduly exalting its importance, with the consequent loss of a proper perspective, and when one sees a comparatively narrow branch of astronomical inquiry, like eclipses, occupying a rather ponderous volume, he may be led to think that the subject has been indiscreetly expanded. We therefore hasten to say that there is no evidence of disproportionate treatment in Mr. Buchanan's book. He himself has been employed for twenty-three years in the office of the "American Ephemeris and Nautical Almanac," and during that time has been responsible for the accurate preparation of the necessary information connected with eclipse prediction. His practical acquaintance with the subject eminently fits him for the task he has undertaken, and his book is a success. The moon's nodes have made more than one complete revolution since he began his work, and an entire series of eclipses has revealed to him their peculiarities and oddities.

The theory of eclipses has been well explained by various astronomers, and practical rules given by some. Hallaschka, in his "Elementa Eclipsium," following the method of orthographic projection, has worked out an example in full. Woolhouse, in the appendix to the "Nautical Almanac" for 1836, not only discussed the subject with great fulness, but gave practical rules for the determination of the phenomena, which for many years were followed in

the preparation of the English ephemeris, and perhaps are so still. Bessel gave a more thoroughly consecutive discussion, which Chauvenet followed in his treatise, and this last forms the basis of Mr. Buchanan's work. The practical part of the arrangement does not seem to be easily systematised. A computer finds some difficulty in translating the formulæ into numbers. There are to the uninitiated continual ambiguities about the quadrants; and the manner in which angles are to be reckoned is frequently a stumbling block to the unwary. Perhaps these little difficulties are more noticeable in Woolhouse's method than in Bessel's, but it is with the view of limiting these troubles and of giving a convenient arrangement to the whole of the work that Mr. Buchanan has written his book. In his time he must have met with all the difficulties with which a young computer has to contend, and must have removed these out of the path of many. Knowing these pitfalls, he has done his best to get rid of them by suitable explanations, and probably with success. But those who have conducted pupils through carefully worked examples know only too well that a fresh set of difficulties is apt to reappear with a new case.

The author has divided his book into two parts. In the first he treats of solar eclipses and the method of deriving the various curves which are necessary for the exhibition of the whole circumstances of the phenomenon on a map. Here we get the north and south limits of total and partial eclipses, the position where the eclipse begins and ends with the sun in the horizon, and one can follow the method by which are drawn those weird curves on the eclipse maps that accompany every nautical ephemeris. By way of adding a little lightness to a rather dreary subject, we may notice some curiosities the explanation of which is not very readily seen without the assistance of a competent guide, such as the occurrence of a north limiting curve of totality falling south of the south limiting curve. Ingenuity might construct some further troublesome problems of this nature when the clue is furnished, and one can imagine an examiner exulting over the discovery of such oddities, affording as they do opportunity for worrying unhappy candidates who fall into his hands.

In the second part of the book we have detailed the method of computing the circumstances of lunar eclipses, occultations of stars by the moon, and of the transits of Venus and Mercury. These are practically particular cases of the same problem as that treated in the first part, simplified by certain conditions. In the case of the lunar eclipse, the absolute position of the moon and shadow are independent of the position of the observer on the earth, and therefore the effects of parallax can be treated much more simply. We notice that the semi-diameter of the shadow is increased by the fiftieth part of its amount, in preference to the older estimate of 1/60, but the whole question of semi-diameters is a troublesome one, which will soon have to be treated with great rigour. The occultation semi-diameter is not altogether satisfactory, and some international convention is needed to secure uniformity. From a letter from Dr. Downing, quoted by the author, we gather that the occultation diameter of the moon, as used in the preparation of the English "Nautical Almanac," differs 2″.36 from that employed in eclipse calculations. But we find a little difficulty in following the author in his reference to authorities. In the matter of lunar parallax, Adams is not quoted, and Lardner's "Handbook of Astronomy," or Proctor on "The Moon," can scarcely be considered original and trustworthy sources. W. E. P.

ENGLISH FIELD-BOTANY.

Flora of Hampshire, including the Isle of Wight. By Frederick Townsend, M.A., F.L.S. Second edition. Pp. xxxviii+658. (London: Lovell Reeve and Co., Ltd., 1904.) Price 21*s.* net.

ENGLISH field botanists frequently complain that the British flora has not yet received the careful critical attention which has been lavished on Continental floras. To a certain extent this is doubtless true. We have no manual that for thoroughness of treatment and wealth of reference to original descriptions and type-specimens can compare with Rouy and Foucault's "Flore de France"; at the same time there is an abundance of valuable information scattered through our numerous natural history journals only waiting for some energetic and widely experienced systematist to collate and bring together in a really satisfactory British flora. There are several botanists eminently fitted for such an undertaking, and it is urgently to be desired that one or more of them should take the matter in hand. Meanwhile, our numerous and rapidly accumulating county floras are paving the way to a complete botanical survey of the British Isles.

In Mr. Townsend's "Flora of Hampshire and the Isle of Wight" we have one of the best books of its class, and the work and careful attention expended upon its production must have been very considerable. The volume opens with a chapter on topography and climate. This is followed by an account of the geological structure of the district, including a summary of Mr. Clement Reid's researches on the fossil seeds of the Stone and Silchester beds of the newer Tertiary formation. In his list it is particularly interesting to notice the names of several plants usually regarded as weeds of cultivation, or as colonists, such as *Brassica alba*, Boiss., *Thlaspi arvense*, L., *Linum usitatissimum*, Linn., and also damson and plum.

The now generally approved method of dividing a district into botanical areas according to its river-systems is here in the main followed, and a useful map of the county is appended. Turning to the systematic section—by far the larger portion of the book—so many points call for attention that it is quite impossible within the limits of a short notice to mention more than a few of them. In the section devoted to Ranunculus, what appears to be a satisfactory account of the forms of *R. acris* is given; this will be appreciated by many collectors. The name *Nymphaea alba*, Linn., is retained instead of *Castalia speciosa*,

Salisb., which found favour in the eyes of the editors of the "London Catalogue" (ninth edition). *Viola calcaria*, Bab., appears as var. β of *V. hirta*, Linn., though the author admits an inclination to regard it as a starved or stunted form rather than a variety. No mention is made of *V. calcaria*, Gregory, which has been cultivated, and appears to be a good species.

V. canina, Linn., is given as synonymous with *V. flavicornis*, Sm., non Forster, while *V. ericetorum*, Schrader, appears as a hybrid *canina* × *lactea*. All botanists will not find themselves in agreement with Mr. Townsend upon this point, for *V. ericetorum* is sometimes abundant where *V. lactea* is extremely scarce. Perhaps it may be hoped that cultivation will settle the question, especially if it be found that hybrid violas obey Mendel's law of segregation.

The list of Rubi brings the number up to eighty-five, making the county, with one exception, the richest in brambles of any in the British Isles. Some useful notes on the genus Erythræa are given, and the variety *sphaerocephala*, Towns., of *E. capitata*, Willd., is beautifully figured; the author now considers that the plant does not merit a varietal name.

Among the Monocotyledons, the Rev. E. F. Linton's *Orchis ericetorum* is fully described. It appears to be a well marked plant, and the fact that it grows only on heaths while the chalk plant is typical *O. maculata* cannot be said to militate against its claim to specific rank in view of the parallel case of distribution of the two plants included under the name *Valeriana officinalis*, Linn. But here again there may be great virtue in cultivation. It is satisfactory to find the truth told about *Ruscus aculeatus*. The plant with staminate flowers has narrower cladodes than the pistillate plant, and there is no evidence for a narrow-leaved and a broad-leaved variety.

In an appendix appear notes on several plants, amongst which are *Stellaria umbrosa*, Opiz, and *S. media*, Linn. (both of which are fully diagnosed), *Prunus spinosa*, Linn., *P. fruticans*, Weihe, *P. insititia*, Linn., and *P. domestica*, Linn. An account of Murbeck's arrangement of the gentians is given, and all the forms of Euphrasia and Salicornia noted in the county are described. So much matter of general interest is brought together that no field botanist, be he a native of the district or a worker in any other part of the country, can afford to neglect this volume.

SANITARY ENGINEERING.

Small Destructors for Institutional and Trade Waste. By W. Francis Goodrich. Pp. 127. (London: Archibald Constable and Co., Ltd., 1904.) Price 4*s.* net.

MR. GOODRICH'S book on "Refuse Disposal and Power Production," which dealt with the problems arising in the disposal of civic waste, was recently reviewed in these columns (May 12, 1904, vol. lxx. p. 25); in the present volume the same author treats of the equally important subject of the disposal of institutional and trade refuse, that is, with the design and working of small destructors. The aim has been to make clear the fact that high temperature working is as vital in the small as in the large destructor.

In an introductory chapter Mr. Goodrich lays down the principles which must be observed in the design of small destructors, and he points out that it is possible to operate at a low working cost such destructors when built on modern lines. The weak points in the design of the earlier forms were precisely those which were found in the early forms of large municipal destructors, namely, low temperature system of working, slow combustion, and inadequate and unsatisfactory methods of feeding the refuse into the cells; these difficulties, however, have all been overcome, and at the present day small destructors for use in institutions such as isolation hospitals, hotels, &c., can be obtained as satisfactory in every respect as the large ones now so commonly employed. On account of the unpleasant substances which have to be dealt with in many of these institutional destructors, they are often neglected, and proper supervision over them is not maintained; this leads to the refuse being improperly fed into the destructor; in a good modern type there is no risk of this misuse, as it is impossible to feed the destructor in any other way than that originally provided by the designer.

A number of typical destructors suitable for such institutions are described and illustrated, the drawings being fairly complete. In thinly populated districts it is often advisable to have a portable destructor, and two very successful ones of this type, namely, a Horsfall and a Meldrum, are described. Such portable destructors would be invaluable during campaigns and in our home training-camps. How dangerous the waste from a large camp may become to health was vividly shown during the inquiry by the Royal Commission into the war in South Africa. Many of the medical witnesses expressed the opinion that hundreds of lives might have been saved had the necessary steps been taken to destroy camp refuse properly and to supervise thoroughly the sanitary condition of camps. In America, which, strangely enough, has lagged behind in the adoption of municipal destructors, there has been a considerable development in the utilisation of the smaller forms, both for hospitals and for hotels. The latter portion of the book treats of the disposal of trade refuse, and the author points out how valuable from the point of view of generation of power this trade refuse often is. Such trade refuse can only be burnt in boilers specially designed for fuel of low calorific power, and where the boilers are properly designed there is no difficulty in utilising it. A number of different types of furnaces and boilers suitable for use with trade waste are described and illustrated in these chapters.

The last few pages of the book are devoted to a discussion as to the advantages of disposing of carcases of diseased and condemned beasts by means of suitably designed destructors. The book will be found, like Mr. Goodrich's other books upon this important branch of sanitary engineering, extremely valuable by all who are engaged in dealing with the disposal of solid refuse. T. H. B.

OUR BOOK SHELF.

La Statique chimique basée sur les deux Principes fondamentaux de la Thermodynamique. By E. Ariès. Pp. viii+251. (Paris: A. Hermann, 1904.) Price 10 francs.

Die heterogenen Gleichgewichte vom Standpunkte der Phasenlehre. Zweites Heft, erster Teil. By H. W. Bakhuis Roozeboom. Pp. xii+467. (Brunswick: F. Vieweg and Son, 1904.) Price 12.50 marks.

THE two volumes under review are concerned with the application of thermodynamics to the problems of general chemistry, but are yet so different in material and in treatment that few points of resemblance may be found between them.

In the book by Lieut.-Colonel Ariès the mathematical derivation of the laws of equilibrium from the fundamental principles of thermodynamics are stated in the most abstract and general form with just sufficient exemplification to indicate the bearing of the deductions on the practical work of physical chemistry. The author uses as characteristic function the thermodynamic potential at constant pressure, and it may be said in a word that his deductions are as simple and concise as the case will allow, the introduction of useless conceptions and formulæ being scrupulously avoided. One noteworthy feature which might with advantage be imitated in other works on thermodynamics applied to chemistry is the postponement of the discussion of the perfect gas to a point in the last third of the volume. The student is only too apt in dealing with the involved formulæ of certain cases of chemical equilibrium to introduce unconsciously into his equations some result which has its origin in a consideration of perfect gases, thereby obtaining a simple result apparently general, but in reality not so. The temptation to do this is greatly lessened by the simplification of the perfect gas being delayed until the general formulæ are well developed. The book is well and clearly written, and those interested in mathematical chemistry will be thankful for this lucid exposition of the subject.

The first part of Prof. Roozeboom's book has already been noticed in NATURE. It dealt with the equilibria of systems of one component. The present volume deals with the equilibria of binary systems, though such is the wealth of material that it has been found necessary to reserve the discussion of many systems presenting special features for a subsequent volume. In contradistinction to the work of Colonel Ariès, there is scarcely a mathematical formula to be found in Prof. Roozeboom's treatise; the graphic method is used to the practical exclusion of others. In the present part there are 150 diagrams, chiefly of curves the co-ordinates of which are pressure, volume, temperature, and composition in some combination. As in the first part, the various equilibria are carefully classified according to the nature of the phases involved, and each class is discussed in detail with the most painstaking completeness, and with full reference to the original sources of the experimental work used in illustration. In general terms the volume may be said to deal with simple solutions, and no one whose interest lies in this direction can afford to dispense with the aid of such a valuable guide to the work already accomplished, and to the theory of the practical work still to be performed. J. W.

The Timbers of Commerce and their Identification. By H. Stone. Pp. xxviii+311. (London: William Rider and Son, Ltd., 1904.) Price 7*s.* 6*d.* net.

THIS work is sure to meet with a cordial reception and to be welcomed by all branches of the timber trade. The information contained in its pages is such that only an enthusiast and expert could bring together with the cooperation of others interested in the growth and utilisation of timber in every part of the globe. In all 247 different species are described, even to the minutest detail. In each case the specific name and authority are stated, and, wherever necessary, to avoid confusion, the synonyms have also been added. Then comes a list of the alternative names, or what we might call the common names. It is a well known fact that frequently one and the same kind of timber receives two different names, whereas two totally different species may be known by the same common name. The vernacular names in foreign languages, so far as they are not to be found in dictionaries, have also been quoted. Following this comes a paragraph dealing with physical characters, &c., such as recorded dry weight, hardness, taste, combustion, character of ash constituents, &c. The grain and bark are next described. The following paragraph deals with the uses to which the timber may be put. The colour is also given as a means of identification, and the anatomical characters, as seen in transverse and longitudinal sections, are fully described.

The author seems to have spared no pains in collecting and authenticating the vast amount of information and details necessary for the above purpose. A very valuable feature of the book are the illustrations, numbering 183 photomicrographs, which represent all the genera mentioned in the text, except where a single illustration serves for more than one genus. In most cases the photographs are taken from transverse sections, though in many cases longitudinal sections are also given. It is stated that the scale of magnification is three times the actual size, and is designed to show the appearance of a transverse section as seen by means of an ordinary hand lens. For those desiring further general information about wood a very useful bibliography is given at the end of the book. Also two appendices are added, which respectively describe the method and apparatus for measuring the amount of resistance in timber to impact and the absorption of water by a given area on any surface of a piece of wood.

At the beginning of the book a very interesting chapter, entitled "Practical Hints," is included, which we are sure will be read with much interest and profit by all those who work with wood. The index is a very complete one, and will render the book invaluable as a ready work of reference.

Verhandlungen der deutschen zoologischen Gesellschaft, for 1904. Pp. 252; illustrated. (Leipzig: Engelmann.) Price 11*s.* net.

THIS valuable publication contains the papers read at the twenty-fourth annual meeting of the society, held at Tübingen on May 24–26, 1904. The congress was opened by an address from Prof. Spengel, in which the society was congratulated on the good work it continued to produce, and especially on recent investigations on the structure of the Protozoa and on the relations of the nucleus to the general mass of protoplasm. To Prof. Blochmann was assigned the pleasant task of welcoming the society to Tübingen. The published papers are sixteen in number, in addition to which were numerous exhibits and demonstrations. Most of the former are of an extremely technical character, and to a large extent interesting chiefly to specialists. Among them we may refer to Prof. A. Brauer's account of recent investigations into the structure of the light-organs of the bony fishes, more especially of the deep-sea forms, in which the question of the relation of these structures to the lateral line system is discussed at considerable length. Dr. von Buttel-Reepen's article on the mode in which the larvæ of the honey-bee are made to assume a particular sex is also one of considerable importance. In the course

of a discussion on the zoological system as commonly taught, Prof. H. E. Ziegler emphasises the view that the rhizopod and flagellate animalcules, together with the Sporozoa, form an allied assemblage, while the ciliated animalcules, both as regards the nature of the nucleus and the mode of reproduction, are altogether different. In a fourth important communication Dr. Bresslau amplifies and illustrates his discovery that the marsupium of the marsupials, in place of being a simple organ, is really formed by the amalgamation of a number of small pouches. These pouchlets, which at first form solid ring-like growths of the epidermis, soon begin to degenerate, and are merged in the wall of the marsupium. R. L.

The Optical Dictionary. Edited by Charles Hyatt-Woolf, F.R.P.S. Pp. x+77. (London: The Gutenberg Press.) Price 4*s.* net.

THIS is an optical and ophthalmological glossary of English terms, symbols, and abbreviations, together with the English equivalents of some French and German terms arranged alphabetically. The meanings are, as a rule, very clearly given, and the book should prove of use to students (especially medical students) who suddenly come upon an unfamiliar term in the course of their general reading. Of course, it must be understood that it is practically impossible to explain properly any scientific term in a line or two, and this is all that is attempted; the meanings given must therefore in most cases be somewhat unsatisfactory. But the book will doubtless succeed in its aim, especially in the translation of foreign terms. As regards accuracy—the *sine quâ non* of a dictionary—we only notice a very few actual errors, *e.g. dioptrically* does not mean *by reflection*, and in the definition of *numerical aperture* the words *refractive index of the medium in which the object is immersed* scarcely indicate that the medium must extend into contact with the objective. *Underlant* is apparently a misprint for *undulant*, and one-third of p. 70 has got into its wrong place.

But these are not very important blemishes, and we cordially recommend the book to those whom it may concern.

Practical Professional Photography. Vols. i. and ii. By C. H. Hewitt. Pp. 126 and 114. (London: Iliffe and Sons, Ltd., 1904.) Price 1*s.* net each.

THESE two volumes form a very useful addition to the *Photography* bookshelf series, of which they form Nos. 17 and 18. Although the author does not profess to go into any great detail, he gives an excellent account of the necessary requirements of the professional photographer, from the choice of business premises, the handling of customers, book-keeping, &c., down to the packing up of the finished pictures and their dispatch. The chapters on portraiture, composition, and lighting are especially satisfactory, and many a valuable hint is contained therein.

A great number of illustrations accompany the text, and serve the useful purpose of illustrating the author's remarks on many lines of work.

Solutions of the Exercises in Godfrey and Siddons's Elementary Geometry. By E. A. Price. Pp. 172. (Cambridge: The University Press, 1904.) Price 5*s.* net.

THIS book will be found very useful to all, both pupils and teachers, who use the well known work of Messrs. Godfrey and Siddons. The solutions, 1836 in number, contain not only the deductive, but the drawing exercises, the figures being all such as the pupil is required to construct. We cannot refrain from pleading for a better figure of a hyperbola than that given on p. 143, which a trained eye rejects at once, although it is not essential to the pupil's work.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Average Number of Kinsfolk in Each Degree.

MAY I ask you to insert yet another brief communication on the above subject, because private correspondence shows that paradoxical opinions are not yet wholly dispelled? The clearest way of expressing statistical problems is the familiar method of black and white balls, which I will now adopt.

Plunge both hands into a dark bag partly filled with black and white balls, equal in number, and well mixed. Grasp a handful in the right hand, to represent a family of boys and girls. Out of this unseen handful extract one ball, still unseen, with the left hand. There will be *on the average* of many similar experiments, as many white as black balls, *both* in the original and in the residual handful, because the extracted ball will be as often white as black. Using my previous notation, let the number of balls in the original handful be $2d$. Consequently the number in the residual handful will be $2d-1$, and the average number in it either of white or of black balls will be half as many, or $d-\frac{1}{2}$. It makes no difference to the average result whether the hitherto unseen ball in the left hand proves to be white or black. In other words, it makes no difference in the estimate of the average number of sisters or of brothers whether the individual from whom they are reckoned be a boy or a girl; it is in both cases $d-\frac{1}{2}$. The reckoning may proceed from one member of each family taken at random, or from all its members taken in turn; the resultant average comes out the same.

This, briefly, is my problem. FRANCIS GALTON.

On the State in which Helium Exists in Minerals.

IN 1898 I published in the *Proceedings* of the Royal Society the results of some experiments on the evolution of gases from minerals on heating them. I succeeded in proving that the hydrogen and carbon monoxide in the gases could be accounted for quantitatively by the reduction of water vapour and carbon dioxide by ferrous oxide, or by similar substances, and that, except in cases in which cavities could be proved to exist, the evolution of a gas from a mineral implied chemical change at the moment of heating. In the cases in which helium was evolved on heating a mineral, I pointed out that by the action of heat it is possible to obtain only half the helium, though the evolution of this gas never really ceases, but only becomes very slow. This I took to be evidence of the existence of a chemical compound of helium with some constituent of the mineral.

Recently (*Trans.* Roy. Dublin Soc., 1904) Mr. Moss has shown that by grinding pitchblende *in vacuo* helium is evolved, and considers this result as certain evidence of the existence of the gas in the free state in cavities. Since, however, helium is evolved, though slowly, from the crushed mineral at a temperature not above 300° C., the liberation of the gas in Mr. Moss's experiment may be attributed to local heating set up in the process of grinding.

In view of recent discoveries it appears to me that both of us have been on the wrong track in looking for an explanation of the phenomenon. As Sir William Ramsay and Mr. Soddy have shown, the presence of helium in the minerals may have resulted from the decomposition of radio-active matter, formerly present in them. Recently Dr. Jaquerod, of Geneva (*Comptes rendus*, 1904, No. 20, p. 789), has found that when helium is heated in a quartz bulb to a temperature above 500° C. the gas passes out through the quartz with a velocity which increases with the temperature. At 1100°, in a comparatively short time the pressure in the bulb fell considerably below that of the atmosphere. Hydrogen appeared to behave similarly.

This experiment shows that quartz, and probably substances of the nature of the minerals we are considering, though impermeable to helium at low temperatures, become permeable at moderately high temperatures, and furnishes us with a solution of the second part of our problem.

I think that we are now justified in assuming that the helium, a product of radio-active change, is present in the minerals in a state of supersaturated solid solution; that the mineral substance being impermeable to the gas at ordinary temperatures, the velocity with which equilibrium is established between the helium in solution and the helium in the gaseous phase is infinitely small, but increases very rapidly with rise of temperature; that as the solubility of helium in the mineral substance is probably very small, the mineral cannot be made to re-absorb the gas. Grinding even to an impalpable powder, if unaccompanied by local heating, should result in the evolution of minute quantities of helium only.

I may point out in conclusion that the "deflagration" which takes place when "fergusonite" is heated, and was taken by Sir Wm. Ramsay and myself to indicate the presence of a chemical compound of helium, also takes place in the case of some minerals which contain no helium.

University College, Bristol. MORRIS W. TRAVERS.

The Pollination of Exotic Flowers.

IN connection with Prof. Groom's article on the pollination of exotic flowers (November 10, 1904, p. 26) the following notes may be of interest. The inflorescence of *Marcgravia Umbellata* is described in Schimper's "Plant Geography," where Belt's description is quoted from the "Naturalist in Nicaragua." The plant is common here, climbing to the summit of the forest trees, and is frequently visited by humming birds. The bird settles on the top of the flowers and inserts its long curved beak into the pitchers below to suck the sweet juice which they contain. I have not seen insects visiting the flowers, neither have I found them in the pitchers, and conclude that the birds are attracted by the sweet juice itself rather than by insects in search of it as Belt suggests.

Flowers with strong scent and brush-like stamens are very common, and one of them, the Pois Doux (*Inga laurina*), is surrounded when in blossom by a motley crowd of bees, large beetles, and insects of every description, as well as by humming birds of several species. The latter certainly visit very different plants, but are most familiar hovering round the banana flowers, sucking the drops of sweet liquid continually oozing from them.

Flowers like the Pois Doux are easily destroyed by heavy rain, and blossom only for a short period. A large number of others are provided with horned stamens, with barren anthers or anther lobes. May not this be a protection against loss of pollen by rain and wind, it being kept in a sheltered situation, and only set free when an alighting insect moves the stamens? It would be interesting to observe how far the abundance of flowers with horned stamens is correlated with heavy rainfall and constant wind.

Dominica, December 13, 1904. ELLA M. BRYANT.

Reversal of Charge in Induction Machines.

I HAVE tried Mr. G. W. Walker's experiment with a small Wimshurst, with 8″ plates, and find that the reversal he mentions generally takes place, but not always. In my case, however, the machine is made so as to excite either way, and the reversal will not take place unless excitation has occurred while the motion is reversed.

R. LANGTON COLE.

Sutton, Surrey, January 6.

EVIL SPIRITS AS A CAUSE OF SICKNESS IN BABYLONIA.[1]

IN a former number of NATURE (vol. lxix., p. 26) the attention of our readers was directed to the appearance of the first volume of a work which Mr. Campbell Thompson, of the British Museum, was devoting to the consideration of the important function which devils and evil spirits were believed to play in the production of disease by the early inhabitants of Babylonia. It was impossible at that time to state the final conclusions at which Mr. Thompson had arrived, for the publication of his work was not completed; but now that we have the second volume in our hands our readers are in a position to judge for themselves of the character and importance of the results, which have now been clothed in the dress of a modern language for the first time. The sources of such results, we need hardly say, are the terra-cotta tablets of the royal library at Nineveh, now preserved in the British Museum, and after a careful examination of Mr. Thompson's volumes we are able to say that the translator has done his best to reproduce the meaning of the documents which he places before us without unnecessary comments or theories.

It must be said at the outset that we do not regard Mr. Thompson's work as final in all particulars, for in respect of many Assyrian texts this work is the *editio princeps*; but none can fail to be pleased with the manifest honesty of the translations, which quite justifies us in overlooking the baldness and crudity of expression which sometimes characterise them. In studies of this kind we want the texts and the best rendering of them possible, but the most important point of all is that the editor should not read meanings into the words of his texts or twist them to suit preconceived notions. It goes without saying that Mr. Thompson's translations will not be accepted by other labourers in his field without reservation. Indeed, we may note in passing that M. Fossey has already animadverted upon them in the *Recueil de Travaux*, in the *Revue Critique*, and in the part of the *Journal Asiatique* just issued. It is no part of our duty here to attempt to vindicate Mr. Thompson's renderings or to belittle M. Fossey's knowledge of the science of ancient magic, but it must in common fairness be stated that the latter *savant* is not skilled in dealing with cuneiform documents except through the medium of the copies of other scholars who have been trained in making transcripts direct from the original tablets, and the mere fact that he condemns Mr. Thompson's derivations from the Syriac proves that he does not comprehend the importance of one northern Semitic dialect in helping to explain another. On the other hand, Mr. Thompson has spent some years in the task of copying the various classes of tablets which he is now editing and translating, and though some may admire M. Fossey's tempting renderings, and prefer them to those of Mr. Thompson, it should be remembered that the translations set forth in the volume before us are those of the skilled workman who is working at his trade, whilst those of M. Fossey are the product of a student of magic and religion in general.

The groups of tablets published by Mr. Thompson are five in number. The first are inscribed with exorcisms and spells which are directed against the disease of ague or fever; the second contain charms and incantations which were intended to do away with headache; the third deal with a series of diseases of an internal character, but it cannot at present be said exactly what those diseases were; the fourth are inscribed with texts written with the view of destroying the "taboo" to which, it seems, man was thought to be peculiarly liable; and the fifth supply descriptions of supernatural beings, among whom may be mentioned a creature who was half woman and half snake. Mr. Thompson identifies her with the goddess Nin-tu, who was the Babylonian equivalent of the Egyptian goddesses Hathor, Isis, Mer-sekert, &c., and the Virgin Mary among Oriental Christian peoples. Like each of those goddesses she was a form of the World-mother, or chief Mother-goddess who plays such an important part in many mythologies. By way of supplement, Mr. Thompson has added the

[1] "The Devils and Evil Spirits of Babylonia." By R. Campbell Thompson. Vol. ii. Pp. liv+179. (London: Luzac and Co., 1904.) Price 12*s*. 6*d*. net.

translation of an ancient prescription for curing the tooth-ache. The sufferer was ordered to mix some beer with oil and with another unknown ingredient, and, having rubbed it on his tooth, he recited the following words three times:—"When Anu had created the heavens, the heavens created the earth, the earth created the rivers, the rivers created the canals, the canals created the marshes, the marshes created the Worm, which came and wept before Shamash and cried out before Ea, saying:—'What wilt thou give me for my food? What wilt thou give me to eat?' To this the Sun-God replied:—'I will give thee dry bones and scented . . . wood.' To this the Worm made answer:—'Of what use are dry bones and scented . . . wood to me? Let me drink between the teeth and let me be at the gums, that I may drink the blood of the teeth and sap the strength of the gums, then shall I be master of the bolt of the door.'" When the patient had said the above, he was ordered to address the Worm and say, "May Ea smite thee with

FIG. 1.—Bronze animal-headed figure of one of the Babylonian Powers of Evil. From "The Devils and Evil Spirits of Babylonia."

the strength of his fist, O Worm!" We can only hope that these potent words relieved the sufferer.

The bulk of Mr. Thompson's present volume is, of course, occupied with the transliterations and literal translations of the documents of which he treats; but, as these are manifestly intended for the expert in cuneiform only, we may briefly note the summaries of their contents, which appear in the preface. The texts which refer to words of power show that they possessed much in common with a similar class of document found in Egypt and elsewhere. The Sumerian magician having found out the name of the devil which caused the sickness he was called upon to cure, proceeded to deal with it by means of sympathetic magic. He employed ceremonies of various kinds, in which magical figures, loaves of bread, pieces of hair, water, a virgin kid, &c., played prominent parts. Sicknesses could be transferred to the dead bodies of kids and pigs, and devils could be made to disappear into masses of water collected in pots, whereupon the vessels themselves would break. In Sumer and Accad knotted cords were much used for purposes of witchcraft, and knotted locks of hair were held to be all-powerful. The section which treats of the ban and taboo is especially suggestive, and we hope that Mr. Thompson will say more on these subjects when he has collected a larger number of examples. Finally, he directs attention to the existence of the word "*Kuppuru*," which is the equivalent in meaning to the Mosaic idea of "atonement," and the texts printed in the volume before us show conclusively that the acts which formed the atonement removed the taboo which man had incurred. The Sumerian ceremonies of atonement were certainly developed out of sympathetic magic, and the examples of atonement given in the Bible show that the ceremonies mentioned were, in more than one case, closely connected with primitive Hebrew magic. Those who are interested in the study of magic in all its forms will find Mr. Thompson's book of considerable interest and importance.

SPEECH CURVES.

AN interesting lecture[1] was recently delivered in the psychological institute of the University of Berlin by Prof. Scripture, of the University of Yale, whose investigations in phonetics are well known. Prof. Scripture's method is that first employed by Fleeming Jenkin and Ewing, and afterwards developed by Hermann, the writer and others, namely, to record on a moving surface, either by photography or by a direct system of levers, the curves imprinted by speech on the cylinder of a phonograph or on the disc of a gramophone. Dr. Scripture has recently improved the mechanism of his apparatus so as to obtain an amplification of the curves, about three times in the horizontal and three hundred times in the vertical direction, while the speed of the movement of his gramophone plate was reduced 126,300 times that at which it rotates during the acoustical reproduction of the sound. His curves have been submitted to analysis, and it shows the energy with which the research is being prosecuted when he is able to state that in America he has twenty persons engaged in this special bit of work.

In the discussion of his results, Prof. Scripture, in the first instance, refers to some remarks by Prof. Sievers, of Leipzig, on what may be called the "melody" of vowels and words. Prof. Sievers says that each line and verse of a poem has its own melody, and that this will be determined by the psychological condition of the individual at the time of its vocal expression. An author, too, while writing a poem, say one of a dramatic character, may give a certain "melody" to the expressions of one individual. Goethe, for example, causes Faust to drop his voice at the close of a sentence, while the voice of Mephistopheles rises and falls in a variable manner. Sievers also points out, as a curious fact, that when Goethe completed the poem, many years after he wrote the earlier portions, he had forgotten these melodic effects, and the later portions have not the same melodic characteristics. Prof. Scripture supports Prof. Sievers's view. This melodic character will thus affect the quality of a vowel sound.

Prof. Scripture holds that the movement of the vocal cords does not produce a sinuous curve, and herein he agrees with Marage, of Paris. By the movements of the cords a number of sudden and more or less violent shocks are given to the air, and each shock is communicated to the air in the resonators. In this way

[1] "Über das Studium der Sprach Kurven." By E. W. Scripture. *Annalen der Naturphilosophie.* (Leipzig: Veit and Co.).

we can interpret the groups of marks made on the wax cylinder of the phonograph. Each group corresponds to a "shock" from the cords, and the smaller curves making up the group are due to the movements of the air in the resonators. Prof. Scripture is not satisfied with the theory of Helmholtz that the resonators develop overtones in a harmonic series, nor with that of Hermann, who asserts that the resonance tones need not necessarily be harmonic. He states that he cannot interpret his tracings by the rigid application of either of these theories, and he lays stress on the fact that the walls of the resonating cavities above the cords are not rigid like the resonators of musical instruments, but are soft, as if the wall were fluid. Such a resonator, he says, will give its own tone in response to all tones. We confess that here we are not able fully to comprehend the author's meaning.

Prof. Scripture endeavours also to establish a close relationship between the form of the vibration of the cords and the action of the resonators. According to him, the form of the vibration of the cord may be altered by changes in the action of the muscular fibres that tighten the cord, so as to produce a tone of a given

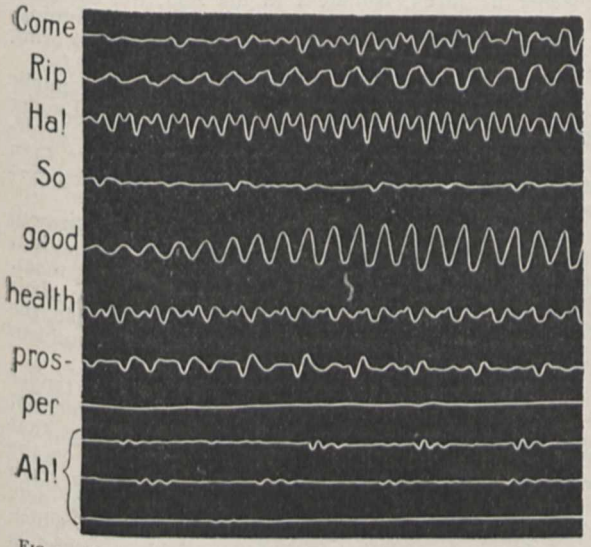

FIG. 1.—Curves of Rip van Winkle's Toast, spoken by the American actor, Joseph Jefferson.

pitch. Assuming that each muscle fibre has a separate nerve fibre (which is highly improbable), one can see that the tension of the cords, even when adapted to the production of a tone of a given pitch, might be so modified as to give out a tone-wave of a special form, and that thus an almost infinite variety of qualities of tone (tone-colours) might be produced. The special quality of tone would thus in the first instance depend on the psychical condition of the individual at the moment. In the next place, according to Prof. Scripture, the "water-wall" resonators, as he calls them, will develop their own tones, independently of the cord-tones, and thus, again, by a summation of these tones, the quality of the vowel-tone may be almost infinitely varied. In this way there is a *physiological* association between the movements of the cords and the action of the resonators.

Prof. Scripture also notes that each vowel has its own harmony, depending on the resonators, and that if it is sounded for even a short time its "melody" may change. This is why it is that when we examine the waves corresponding to a vowel as transcribed from the gramophone they are often seen to change in character as we approach the end of the series of waves. The writer can corroborate this view from his observations by his own method of recording directly the vibrations of a phonograph recorder on a rapidly moving glass plate.

Prof. Scripture also points out a fact that was soon apparent to all observers in experimental phonetics, namely, that in the records of the phonograph or gramophone there are neither syllables nor intermediate glides, but a succession of waves, infinitely diverse in form, corresponding to the tones of the voice or the sounds of any musical instrument. The sound of a single vowel may be in a groove a metre long on the wax cylinder of the phonograph, and in the bottom of this groove there may be thousands of little groups of waves. The writer possesses records of songs that if drawn out would be 100 metres in length. Finally, Prof. Scripture lays emphasis on the effect of varying intensity as influencing quality. Apart from the theory of vowel-tones advanced by the author, this interesting lecture owes its value to the way in which Prof. Scripture approaches the problem from the physiological and psychological side. The mode of production of vowel-tones is in this sense not entirely a physical problem. We are dealing with living cords moved by living muscles, and with curiously shaped resonators having living walls.

JOHN G. MCKENDRICK.

GEOLOGY OF SPITI.[1]

THERE are spots, insignificant in themselves, which have a world-wide celebrity among those interested in certain pursuits or investigations. Such is Gheel to the alienist, Shide to the seismologist, or Bayreuth to the musician, and such, too, is Spiti, a barren and sparsely inhabited valley in the centre of the Himalayas, which has long been known to geologists for its extensive series of richly fossiliferous rocks. A district like this could not long escape the notice of the Geological Survey of India, and one of the earliest volumes of its memoirs is that by Dr. F. Stoliczka and F. R. Mallet. Published in 1864, this remained the standard, and practically the only, description of the geology of Spiti until the publication, in 1891, of Mr. C. L. Griesbach's memoir, in which, while adopting his predecessors' mapping in the main, he introduced great modifications in the sequence. Neither of these descriptions, however, is entitled to rank as more than a reconnaissance, but now we have the results of what may fairly be described as a survey of this region, and, in an interesting and clearly expressed memoir, Mr. Hayden has gone far towards clearing up the points which were in dispute. In all cases where he has found himself at variance with his predecessors' conclusions he has produced good evidence, and it is in one way satisfactory that he is generally in agreement with the one who can no longer defend his views.

The Spiti valley contains representatives of every series from Cretaceous to Silurian, and a Cambrian age is inferred for a series of sedimentary, but unfossiliferous, beds underlying the latter. In all these Mr. Hayden not only collected from known, but also discovered several previously unknown, fossil-horizons, among the most interesting of which we may mention that of the land plants of Culm age. In the Silurian he has restored Stoliczka's correlation and fully supported it by fossil evidence; on the other hand he has confirmed Mr. Griesbach's discovery of Lower Triassic beds, and his conclusion that there is, in Spiti, a continuous conformable sequence from Permian to Upper Trias, and in this connection has rendered ample

[1] "The Geology of Spiti, with Parts of Bashahr and Rupshu." By H. H. Hayden. (*Memoirs* of the Geological Survey of India, vol. xxxvi, part i.) Pp. vi+129; illustrated. (Calcutta: Government Printing Office, 1904.)

acknowledgment of the work of the late Dr. A. v. Krafft, by whom it had been intended that the description of the Triassic rocks should be undertaken.

A chapter is devoted to the correlation of the unfossiliferous sequence of the outer Himalayas with that in Spiti, and an impartial account is given of the guesses—they are nothing more—which have been made. Mr. Hayden does not attempt to deliver judgment on this vexed question, but seems inclined towards Dr. Stoliczka's view; in this we think that he has not taken sufficient account of what may be called extra-Himalayan considerations. The differences between Spiti and the outer Himalayas, the long sequence of fossiliferous rocks in the one, the complete absence of fossils in the other, seem to admit of only two explanations—either the rocks of one area are unrepresented in the other, or the conditions of deposition were so dissimilar that lithological similarity in the two areas is not to be looked for, and either supposition precludes all hope of direct correlation.

FIG. 1.—Muth Quartzite at Head of Teti River, Bashahr. 6, Daonella Shales; 5, Muschelkalk; 4, Lower Trias; 3, Productus shales; 2, Muth Quartzite; 1, Silurian limestone. From "The Geology of Spiti."

The memoir is indexed and illustrated by plates, several of which are reproductions of photographs by the author; it bears the stamp of careful work, and is worthy of the reputation of the Geological Survey of India. We regret that we cannot say as much for the method of stitching adopted by the Calcutta Government Press; the book may be re-bound, but the torn and mangled leaves can never make a seemly volume.

SIR LAUDER BRUNTON ON THE NEED OF PHYSICAL EDUCATION.

THE report of the inter-departmental committee on physical deterioration, while in the absence of scientifically ascertained data it hesitated to pronounce the evil it investigated to be widespread, has pointed us all to a better way, and Sir Lauder Brunton in these two addresses[1] drives home the lesson.

[1] January 5.—National Federation of Head Teachers' Associations, "The Proposed National League for Physical Education and Improvement."
January 6.—Incorporated Society of Medical Officers of Health, "The Report of the Inter-Departmental Committee on Physical Degeneration."

In speaking at Cambridge to the Head Teachers' Association on the National League, which owes its inception to his statesmanlike grasp of the psychological moment at which to enlist the sympathy and interest of the nation, half alarmed, half repentant of its easy optimism and *laissez-faire*, Sir Lauder Brunton went direct to the point—

How can we alter most surely and speedily those conditions which tend to physical deterioration?

The answer lies in a nutshell. By training the young to open-air work and play, to care of teeth and exercise of muscles, the girls in preparation of appetising food, the boys in such drill as will make them real defenders of their country.

We may not go so far as Sir Lauder in his belief in the educative value of the wall picture of the ravages of the tubercle bacillus—we remember the fearful joy with which we contemplated a ghastly picture of volcanic colouring which an old lady assured us was an accurate delineation of a drunkard's stomach—nor do we think his picture of the country cottage altogether accurate; but he has seized the fact that the master of the situation is the teacher, and to the teacher he turns, confident in his zeal, his devotion, his stimulating propaganda, his patient training, confident, too, in the plastic material our schools bring to his hand.

To another large class of workers in the public service, the medical officers of health, Sir Lauder Brunton also appeals. He pointed out to the Incorporated Society that physical efficiency is more than doubtful in the mass of people even if physical deterioration is unproved.

For accurate data as to height and weight, growth and physical development of the youth of the nation, we must look to the teachers in daily touch with them. Such data have hitherto been conspicuous by their absence, but once in existence they will enable the statesman and statistician alike to realise the problem they have to solve.

This involves periodical measurement, and to render their task effective the teachers will need instruction, and the most likely person to be called in to give that instruction is the M.O.H. Without trenching on the medical profession the teacher may learn from them to detect signs of fatigue or mental strain, to note defective vision and physical weakness, all of which too often escape notice until irremediable mischief is done.

Sir Lauder Brunton dwelt on the question of the milk supply, the feeding of underfed school children, and the housing question, and warmly endorsed the committee's recommendation that the medical officer of health should have security of tenure in view of the local jealousies he may arouse, the local prejudices he may cross. Discussing the report, Sir Lauder Brunton approved the desire for a Board of Health to undertake some of the duties of the over-worked Local Government Board; failing such a board, he cordially welcomed the idea of an advisory council for matters concerning the national physique, such council to consist of representatives of the Departments of State reinforced by men of science and by experts in questions of health and of physical development.

He is assured of the readiness of the medical profession to do their part in the educative work; he believes in equal readiness of the teachers to learn and teach what it is of vital importance the coming generation should acquire, not only theoretically, but practically—a knowledge of the laws of health.

The National League for Physical Education and Improvement has so far been mainly confined to the medical profession, but now that its aims are focused and defined Sir Lauder looks to a wider public. He

hopes that before long not only every medical officer of health and every school teacher, but every man and woman who knows what is needed, will join its ranks. Thus will be formed that body of enlightened public opinion which is the moving power in every reform worked, in every advance made by nation, district, or parish, and thus the gospel of physical culture and healthy environment may win its way to every British home. No more patriotic work can be imagined, even though "the foes be they of our own household."

NOTES.

THE council of the Geological Society of London has decided to award the medals and funds this year as follows:—Wollaston medal to Dr. J. J. Harris Teall, F.R.S.; Murchison medal to Mr. Edward John Dunn, of Melbourne; Lyell medal to Dr. Hans Reusch, director of the Geological Survey of Norway; Bigsby medal to Prof. J. W. Gregory, F.R.S.; Wollaston fund to Mr. H. H. Arnold-Bemrose; Murchison fund to Mr. H. L. Bowman; and Lyell fund to Mr. E. A. Newell-Arber and Mr. Walcot Gibson.

ST. MARGARET'S BAY, Dover, where great falls of cliff frequently occur, was the scene of another landslip on Tuesday, January 10, when an enormous slice of the cliff, estimated by the coastguard at about a quarter of a million tons, fell into the sea. The fall occurred a little to the eastward of the bay, where the cliff is about 250 feet high. When the fall took place, about 9.30 a.m., it is said that a very sharp earth tremor was felt throughout the village, and was at first believed to be an earthquake. A further fall occurred at noon. As the result of these landslips a gap about 200 feet wide and 50 feet deep appears in the cliff. The débris at the foot of the cliff covers a large area with some very large fragments of rock. The mass is 20 feet or 30 feet high, and extends seawards about a quarter of a mile.

WE learn from the *Times* that an International Archæological Congress will be opened at Athens by the Crown Prince of Greece on April 7. The opening meeting will be held in the Parthenon, and M. Carapanos, the Minister of Public Instruction, will address the members of the congress. The director of Greek antiquities and the directors of the foreign schools will give an account of the progress of archæological research in Greece. The congress will be divided into seven sections:—(1) classical archæology; (2) prehistoric and oriental archæology; (3) excavations, museums, and preservation of monuments; (4) epigraphy and numismatics; (5) Byzantine archæology; (6) instruction in archæology; (7) geography and topography.

A SLIGHT earthquake shock which lasted a few seconds was felt at Gibraltar on January 7, at 5 a.m. No damage was done. The disturbance was also felt in the Spanish towns of Algeciras, Campamento, and San Roque. At La Linea there were two severe shocks, each lasting about five seconds, the first occurring at 4.40 a.m., and the second at 4.52 a.m.

ON Tuesday next, January 17, Prof. L. C. Miall will begin a course of six lectures at the Royal Institution on the "Structure and Life of Animals." The discourse on Friday, January 20, will be delivered by Sir James Dewar on "New Low Temperature Phenomena," and on January 27 by Dr. E. A. Wilson on "The Life of the Emperor Penguin."

WE regret to see the announcement of the death of Mr. G. W. Hemming, K.C., in his eighty-fourth year. In addition to contributions extending over many years to various magazines and periodicals, he was the author of a "Differential and Integral Calculus," which appeared in 1848, and also of a work entitled "Billiards Mathematically Treated" (1893), of which a second edition was recently published.

THE death is announced of Mr. Robert Harris Valpy at the advanced age of eighty-five. Although a keen geologist, he published very little, but he made a very fine collection of fossils from the Devonian rocks of North Devon, and his assistance was acknowledged in the late Mr. Etheridge's work on the "Physical Structure of West Somerset and North Devon" (1867). Mr. Valpy was the author of "Notes on the Geology of Ilfracombe and the Neighbourhood," published anonymously by Twiss and Sons, of Ilfracombe.

THE first award of the Henry Saxon Snell prize will be made this year by the Royal Sanitary Institute. The prize was founded to encourage improvements in the construction or adaptation of sanitary appliances, and is to be awarded by the council of the institute at intervals of three years. The first prize, which will consist of 50*l.* and a medal of the institute, is offered in the year 1905 for an essay on "domestic sanitary appliances, with suggestions for their improvement." Essays must be delivered on or before March 30, addressed to the secretary of the Royal Sanitary Institute, 72 Margaret Street, W.

THE Association for Maintaining the American Women's Table at the Zoological Station at Naples and for Promoting Scientific Research by Women announces the offer of a third prize of 200*l.* for the best thesis written by a woman, on a scientific subject, embodying new observations and new conclusions based on an independent laboratory research in biological, chemical, or physical science. The theses offered in competition are to be presented to the executive committee of the association, and must be in the hands of the chairman of the committee on the prize, Mrs. Ellen H. Richards, Massachusetts Institute of Technology, Boston, Mass., before December 31, 1906. The prize will be awarded at the annual meeting in April, 1907.

THE death is announced of Mr. Beauchamp Tower, who was associated for some years with Mr. W. Froude, F.R.S., in the experiments made for the Admiralty on the models of ships and on full-sized vessels and engines of the Navy, from which experiments much of the present knowledge of the scientific design of ships has been derived. While working as a consulting engineer, says the *Times*, Mr. Tower developed several ingenious inventions, notably a machine to carry out Mr. Spencer Deverell's idea of obtaining work from wave motion, the well known "spherical" steam-engine, largely employed for some years where high rotary speeds were needed, a centrifugal pump revolution indicator for ships, and a gyroscopic steady platform for guns at sea, all of which afford good examples of originality and scientific acumen. He also undertook for the Institution of Mechanical Engineers, and carried to a successful issue, an extremely complete series of experiments on friction, by which much new knowledge on the subject was gained.

LONDONERS probably began to realise that the electrification of the "underground" railways was nearing completion when, last week, a partial electrical service was started on the section of the lines running from Baker Street to Harrow and Uxbridge. This marks the first step in the change which will be carried out by degrees

over the whole system, the electrical trains being at first run in place of some only of the regular trains, their numbers being increased until eventually the complete service is electrical. When this has been effected, and the steam trains entirely displaced, the cleaning of the stations and tunnels will be taken in hand; it is not until this is complete that the public will derive the full benefit of the alteration, so it is to be hoped that no difficulties will be experienced to cause delay. It has been no small undertaking to prepare everything for the conversion of these lines, and the actual change itself must necessarily be carried out with care, especially as it has to be effected without interruption of the traffic.

M. H. BOURGET, of the University of Toulouse, writes to ask what is the form of the surface of a fowl's egg, and if precise measures have been made of eggs in order to determine whether the shape is constant and approaches that of any known geometrical figure. In reply to this inquiry, Prof. G. H. Bryan, to whom the matter was referred, remarks:—"I believe it is generally recognised that the shape of the meridian section of an egg is most approximately a Cartesian oval, that is, a curve given by the equation $ar_1+br_2=c$, where r_1 and r_2 are distances from two fixed points. For $a=b$ this becomes an ellipse, but with a and b unequal we get a figure with one end more rounded and one more pointed, very like an egg. But anyone who tried to find mathematical equations for the curves occurring in the forms of organic life would have a difficult task, especially if he were to tackle the Diatomaceæ. It should also be remembered that the number of curves which have an equation is infinitely small compared with the number of curves that cannot be so represented."

THE annual report of the Russian Geographical Society for 1903 has only just reached us. Among the scientific explorations accomplished during the year we notice the explorations of Lake Balkhash by M. L. S. Berg, of Lake Kosogol by M. V. S. Elpatievsky, of Lake Ladoga by M. J. M. Shokalsky, and of various lakes in European Russia, as also of Lake Gokcha, by several students under Prof. D. N. Anuchin. M. V. I. Lipskiy has continued to study the flora of Central Asia, in connection with his forthcoming work on this subject, and has made for this purpose interesting journeys in the Tian-Shan, while the range of Peter I. has been further explored by M. V. Th. Novitzkiy. The botanist, M. J. N. Voronoff, explored north-western Mongolia, M. N. B. Grinevetskiy the flora of Transcaucasia, V. A. Faussek the Transcaspian fauna, and V. E. Petersen the Lepidoptera of the Urals. A journey in the Pechora region, by P. P. Mataftin, is also worthy of notice. Several expeditions—Dr. Zarudnyi in Persia, Syeroshevskiy, explorer of the Ainos, in Yezo, Karskiy in White Russia—were at work during the same year, as also the committee for the scientific collection of folk-songs, with their music.

AT the meeting of the Institution of Civil Engineers held on January 10 Sir William White, K.C.B., delivered an address on the recent visit of the institution to the United States and Canada. He described the visits made to the principal engineering works in New York City and district, to those in Canada, and to similar enterprises in Chicago. In Canada, many opportunities were afforded to see examples of the utilisation of water power, and no one could fail to realise the enormous possibilities of development in the pulp and paper industry, with cheap power and a good supply of labour. The visitors were informed that within a few miles of Ottawa there is 200,000 h.p. of water power, and within a radius of forty-five miles nearly a million horse-power. At Niagara on the Canadian side three new undertakings are being rapidly advanced, together giving more than 400,000 h.p., while a fourth will yield 40,000 h.p. When these are completed the grand total of power derived from Niagara on both sides of the river will be about 700,000 h.p. These particulars were followed in the address by an account of the International Engineering Congress at St. Louis organised by the American Society of Civil Engineers. Concluding, Sir William remarked that there can be no doubt but this visit enabled American and Canadian engineers to give practical proof of their fellowship with British engineers. The visit must tend to strengthen the friendly feeling already existing between the United States and the British Empire. It must result also in a better understanding between the mother-country and Canada.

A VALUABLE report by Dr. Musgrave and Mr. Clegg on pathogenic amœbæ, the cultivation of amœbæ, and amœbic dysentery, has been issued by the Bureau of Government Laboratories, Manila (No. 18, 1904). It is considered that all amœbæ are, or may become, pathogenic. Pure cultures of amœbæ were obtained by a modified plate culture method, but it was not found possible to cultivate the organisms unless bacteria were present in the cultivations, and the amœbæ were often found to exhibit a preference for certain species of bacteria.

THE United States Department of Agriculture has added to its valuable memoirs on food and diet a report by Messrs. Woods and Mansfield on the food of the Maine lumbermen (*Bulletin* No. 149, 1904). These men perform hard manual labour, and are much exposed to cold, wet, and hardship, and the staple daily fare consists of pork or beef, sour dough biscuits made of dough which undergoes fermentation with a "wild" yeast, tea and molasses, and beans which are first parboiled in the forenoon, and are then packed with alternate layers of salt pork in a pot which is covered with hot ashes and earth, and allowed to cook over night. It is considered that the dietary, as regards protein and energy, is the highest yet recorded for any American labouring men, is well digested, and costs about 23·5 cents per person per diem.

WE have received a copy of the third and final part of a "Catalogue of Canadian Birds," by Mr. J. Macoun, issued by the Geological Society of Canada, which deals with such families of the Passeres as were not included in the preceding part. Owing to the fuller knowledge of the habits of most of the birds recorded in this part, as compared with those in its predecessors, a larger amount of space is devoted to the majority of the species, thereby enhancing the value of the work. Otherwise the method of treatment is the same as that adopted in parts i. and ii., which have been previously noticed in our columns.

IN the eighteenth annual report of the Liverpool Marine Biology Committee, dealing with the new biological station at Port Erin, Isle of Man, the director deplores that while there have been more students than in any previous year (who have worked harder than their predecessors) and more investigators engaged on original work, to say nothing of the success of the public meetings and the excellent result of the fish-hatching, yet the number of subscribers does not increase; and, in truth, the list of subscriptions to such an admirable institution is but a pitiful one—a total of 89*l.* 3*s.* 6*d.* The marvel, indeed, is how so much good work is accomplished and the establishment kept in going

order on an income of 176*l.* 14*s.* 1*d.* Apparently, however, there must be some other fund for the up-keep of the building, as there are no items in the account for caretaker's wages or for repairs. The committee has been unfortunate in losing several influential friends and supporters, among them Dr. Isaac Roberts, during the past year, and regret is expressed that it becomes increasingly difficult to find men of the same stamp among the younger generation to fill their places. The report is illustrated with figures of the early stages of the development of the lobster and of the plaice. Although plaice-hatching was fairly successful, results were by no means so good as regards the rearing of lobsters. After one failure 5000 larvæ were successfully hatched; but of these, despite every care, very few attained the "lobsterling" stage. It is incidentally recorded that the female spiny lobster (*Palinurus vulgaris*) destroys her eggs in captivity. The general interest of the report is much enhanced by an illustrated account of Manx (or "Manks") antiquities, inclusive of fossil mammals, by Messrs. Kermode and Herdman.

In the *Sitzungsberichte*, No. 22, of the Imperial Academy of Sciences in Vienna, Mr. J. Dörfler gives an itinerary of a six months' tour in the island of Crete, undertaken for the purpose of collecting botanical specimens. From this point of view the journey was very successful, as 1200 plants were obtained, including *Triadenia Sieberi*, *Senecio gnaphalodes*, and the tiny *Bellium minutum*.

Two rare seaweeds, Rhipidosiphon and Callipsygma, both referred to the Codiaceæ, form the subject of a short article contributed by Mr. and Mrs. A. Gepp to the *Journal of Botany* (December, 1904), and Mr. Salmon presents a second instalment of his notes on Limonium. The second supplement (1898–1902) to the biographical index of British and Irish botanists, compiled by Mr. J. Britten and Mr. C. S. Boulger, is concluded in the same number.

In addition to the maintenance of the more ornamental gardens, the director of the Public Gardens, Jamaica, in his report for the year 1903–4, describes a number of experiments which have been carried on at the Hope Experiment Station. With the view of combining the good qualities of different varieties of pineapples, a number of hybrid seedlings have been raised by crossing the Cayenne, Ripley, and Queen varieties. The method of growing Sumatra wrapper-tobacco under tent-cloth, as practised in the Connecticut valley in America, was tried with good results, but the climate at Hope was found to be too dry for curing the leaf satisfactorily. Considerable success has attended the budding of mango, nutmeg, cocoa, and other trees, and the process is strongly recommended, both as a means of rapid propagation and also with the object of improving the fruit.

We have received a further instalment of the States gazetteers, already noticed, in the "Gazetteer of West Virginia," by Mr. Henry Gannett, published by the United States Geological Survey.

The August and September (1904) numbers of the *Bollettino* of the Italian Geographical Society contain an extremely interesting and suggestive memoir by Prof. Gustavo Coen on the supposed decadence of Great Britain and the awakening of eastern Asia. The conclusions of the paper, which cannot be briefly summarised, are obviously the result of wide study and research, and should be of great value to geographical and political students in this country.

In a paper published recently in the Hungarian *Mathematischen und naturwissentschaftlichen Berichte* Dr. von Kalecsinszky gives an account of further observations and experiments on the warming of different layers of liquid by the sun's rays. Observations in lakes in which salt water is covered over with a stratum of fresh water show that the salt water may be warmed to a much higher temperature than the overlying fresh water. Experiments with solutions of magnesium sulphate, sodium sulphate, ammonium chloride, and sodium carbonate, and with fresh water covered with petroleum and with olive oil, gave similar results. It is concluded that the phenomenon is of general occurrence, and that it is a factor of geological importance in the formation of certain deposits.

The United States Weather Bureau has reprinted Mr. W. L. Moore's article on climate, written for the "Encyclopedia Americana," as No. 34 of its *Bulletins*. It embraces only thirteen pages of large octavo size, and is written in clear, simple language that can be understood by all. It contains in this small space a large amount of useful information relating to the effects of solar energy, distribution of land and water, and mountain ranges. With regard to secular variations, the author is of opinion that there has been no appreciable change in the climate of any large area within the period covered by authentic history.

We have received from the observatory of the University of Odessa a copy of its *Annals* for the years 1901–3. The observatory having then completed the tenth year of its existence, the volume in question includes, in addition to observations taken thrice daily, and the monthly and yearly results for 1901–3, a valuable series of means for the ten years 1894–1903. The observatory is situated in latitude 46° 26′ N.; the mean temperature is given as 28°·8 in January and 72°·1 in July. The absolute maximum was 94°·3, and the minimum −10°·3 F.; the temperature of the ground is observed at various depths. The annual rainfall is only 13 inches; the wettest month is June (2·3 inches).

We have received a copy of the report of the International Meteorological Committee's meeting at Southport in September, 1903. The meeting was well attended, and various subjects of interest were discussed, including the valuable reports by subcommittees and by individuals; these reports are printed *in extenso* in the appendix. Five of them refer to the arrangements existing or proposed for the exploration of the upper air by means of balloons and kites, and to the results hitherto obtained. Much credit is due to M. Teisserenc de Bort, who, in addition to the stations he has established at Trappes and Itteville, near Paris, has been chiefly instrumental in establishing similar stations at Moscow and Viborg (Denmark). This latter enterprise is acknowledged to be a most important contribution to meteorological science. Appendix vii. is a very valuable report by Sir Norman Lockyer on simultaneous solar and terrestrial changes, which may have an important influence on the meteorology of the future. After summarising the investigations made from earliest times, he points out the considerable advances made during the last quarter of a century. Among the other appendices we may specially mention two by Prof. Pernter (chief of the Austrian Meteorological Service) and by M. Rykatcheff (director of the Russian Service) on the use of the hair hygrometer instead of the wet-bulb thermometer. This instrument is found to be of much service in times of severe frost. M. J. Violle contributes a valuable report on radiation. The author points out that the question is exceedingly complex, and demands a complete study of each of the simple radiations which go to make up the total solar radiation. The International Meteorological Committee voted for the convening of a conference of all directors of meteorological offices, to be held at Innsbruck in September, 1905.

MESSRS. J. J. GRIFFIN AND SONS have sent us specimens of "Vitro-Ink," which is a non-corrosive ink for writing on glass, celluloid, wood, or other material. The ink may be used with an ordinary pen, and flows quite readily. A useful property is that it may be completely removed by means of a damp cloth at any time before it has set hard, so that mistakes can be rectified without difficulty. The ink will be found of especial service in labelling such things as laboratory or photographic dark room bottles, where labels of ordinary type quickly become discoloured or worn away. When written on with vitro-ink the inscriptions entirely resist strong acids, and it is only prolonged action of strong alkalis or boiling water which may efface the material. Microscopic slides, lantern slides, and glass or celluloid photographic negatives may be labelled and numbered direct, and as the ink is quite unaffected by alcohol it can also be employed for biological or other specimens which it may be necessary to preserve in spirit. Another useful field for this ink will be in the rapid production of diagrammatic lantern slides for class or lecture illustration, as the design may be drawn direct on the glass during actual projection, thereby placing considerable facilities in the hands of lecturers or others desiring to employ the screen in place of a blackboard or prepared wall diagrams. The ink can be especially recommended to photographers as an efficient labelling agent, showing good contrast in the dark room light, and capable of being washed clean instantly whenever the names become stained from the unavoidable oxidation of the various solutions employed.

MR. A. HENRY SAVAGE LANDOR'S new book, "Tibet and Nepal," will be published within the next few days by Messrs. A. and C. Black.

MESSRS. GEORGE BELL AND SONS have published a teacher's edition of part i. of "Elementary Algebra," by Messrs. W. M. Baker and A. A. Bourne. The arrangement by which the answers are printed on the page opposite to the examples which are to be given to pupils to work out should prove convenient for the teacher during class work.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A SIXTH SATELLITE TO JUPITER.—A telegram received from the Kiel Centralstelle announces the discovery of a sixth satellite to Jupiter by Prof. Perrine. The existence of the object was suspected in December, 1904, and was confirmed by an observation made on January 4. The position angle on that date was 269°, and its distance from the planet 45′, the latter quantity decreasing 45″ daily, whilst the apparent motion was retrograde.

A later communication from Kiel states that the discovery was made with the Crossley reflector, observations of the satellite having been made on December 3, 8, 9, and 10, 1904, and January 2, 3, and 4.

COMET 1904 *d* (GIACOBINI).—Another set of elements and an ephemeris for comet 1904 *d* have been calculated by Herr M. Ebell from positions determined on December 17, 21, and 26, 1904, and are given below.

Elements.

T = 1904 November 4·22 (Berlin).

∞ = 41° 15′·6
☊ = 218 32·0 } 1904·0
i = 99 39·1
log *q* = 0·27536

Ephemeris (12*h*. *Berlin*).

1905	α	δ	log Δ	Brightness
	h. m. s.	° ′		
Jan. 12 ...	17 29 10 ...	+40 37 ...	0·3451 ...	1·01
,, 14 ...	17 36 1 ...	+41 42		
,, 16 ...	17 43 2 ...	+42 47 ...	0·3438 ...	1·00

(Kiel *Circular*, No. 71).

ELEMENTS AND EPHEMERIS FOR COMET 1904 *e*.—The following elements and ephemeris for Borrelly's comet (1904 *e*) have been calculated by Dr. Elis Strömgren from the positions determined on December 31, 1904, January 1 and 2 :—

Elements.

T = 1905 January 1·2710 (Berlin).

∞ = 341° 23′·22
☊ = 69 54·82 } 1905·0
i = 35 30·70
log *q* = 0·19344

Ephemeris 12*h*. (*Berlin*).

1905	α	δ	log Δ	Brightness
	h. m. s.	° ′		
Jan. 12 ...	1 33 39 ...	+1 17·4 ...	0·0870 ...	0·83
,, 16 ...	1 40 8 ...	+4 18·7 ...	0·0985 ...	0·78
,, 20 ...	1 46 56 ...	+7 13·6 ...	0·1107 ...	0·73

Brightness at time of discovery = 1·0.

According to the above the comet will pass through the south-eastern corner of the constellation Pisces into Aries, and will be about twenty-five minutes west of α Piscium on January 12 (Kiel *Circular*, No. 72).

COLOURS OF STARS IN THE SOUTHERN HEMISPHERE.—During the period October, 1903–March, 1904, Dr. J. Möller, whilst cruising in the tropical regions of the Atlantic and Pacific Oceans, made a number of observations of the colours of 169 stars situated between declination −20° and the South Pole, all of which were about magnitude 3·5.

The results of these observations are published in No. 3980 of the *Astronomische Nachrichten*, where the observer also shows the reduction of his colour values to Osthoff's scale and the differences between his own results and those obtained by the latter observer.

"THE HEAVENS AT A GLANCE."—The handy card calendar, "The Heavens at a Glance," published by Mr. Arthur Mee, Llanishen, price sevenpence, post free, is full of useful information for amateur astronomers. Among other things it contains a "celestial diary" which gives all the more important astronomical events during each month, a table showing the elements of the sun and planets, and a mass of information relative to the brighter stars, variable and double stars, and star clusters and nebulæ.

Intended to hang on the observatory wall, the calendar forms a most useful adjunct to the more voluminous almanacs which it epitomises.

ASTRONOMICAL "ANNUARIO" OF THE TURIN OBSERVATORY.—The first annual publication of the Turin Observatory appeared in the year 1787, but for various reasons their appearance has not been continuous. A new series commences with the "Annuario" for the present year, and in the preface Signor Boccardi, the director, explains its *raison d'être* by the statement that it does not contain the ephemerides, star-places, &c., published in the larger national almanacs, but deals more especially with the calculations and researches made at the Turin Observatory, and fills up the gaps left by those almanacs.

As examples of this we may mention the tables which contain the mean positions and the apparent positions at upper culmination (Greenwich meridian) of 202 stars not included in the "Nautical Almanac," the "American Ephemeris," or the "Connaissance des Temps." The heliocentric coordinates of Jupiter and Saturn (for 1905 and 1906), the elements and ephemerides of various minor planets, a mass of meteorological data, and a review of the meteorology of 1903 are also given.

ORIGIN OF LUNAR FORMATIONS.—In a paper on "A Possible Explanation of the Formation of the Moon," read before the Royal Society of Edinburgh on November 21, 1904 (see NATURE, December 8, 1904, p. 143), Mr. G. Romanes showed that there had never been sufficient heat developed in the interior of the moon by gravitational compression to account for volcanic action on its surface; and he explained how lunar markings could be accounted for on his hypothesis by the impact of meteoritic masses. Dr. Johnston-Lavis writes to say he has long held this view, and reminds us that Dr. G. K. Gilbert developed the impact theory of the formation of lunar craters several years ago (see *Bull.* Phil. Soc. of Washington, vol. xii., pp. 241–292, and NATURE, vol. xlviii., p. 82, May 23, 1893).

PLANT ASSOCIATIONS IN MOORLAND DISTRICTS.

DURING the last four years systematic observations have been made on the distribution of the various associations of vegetation covering the moorland region lying to the east of the Vale of Eden.[1] The boundaries of each plant association have been traced out in the field and laid down on the six-inch Ordnance map, and reduced to the one-inch map for publication. The factors governing the distribution of plant associations over such a limited area are mainly edaphic, although the differences in altitude, which amount to about 2500 feet in the area in question, produce changes in the vegetation which are chiefly due to climatic conditions. Much of the vegetation at present covering cultivated areas in Britain owes its distribution to artificial agencies, edaphic and climatic factors being to a great extent masked. The more remote moorland districts of the north of England and Scotland, however, give opportunities for studying plant associations the distribution of which is chiefly determined by edaphic and climatic factors, the artificial factors due to the influence of man being secondary.

The most important artificial agencies tending to modify the natural distribution of vegetation covering our moorlands at the present day appear to be drainage operations and grazing of cattle. On many of the alpine moorlands these factors are almost negligible, and any change in the vegetation has been caused, not by artificial agencies, but by secular changes in climate. The evidence of a change in vegetation, both on the alpine moorlands of England and Scotland, is unmistakable, and it is possible to a certain extent to reconstruct the waves of vegetation which have occupied the areas mentioned since the passing away of the last ice sheet.

FIG. 1.—Succession of moorland vegetation. Eriophorum Bog on the summit plateau. Nardus Grass Heath developed on the slopes below, changing to Grass Heath with Eriophorum as the wet, gently sloping foreground is reached. From the *Geographical Journal*.

The district in which mapping has been carried on by the author consists of a great extent of bleak, gently sloping moorland, of which about 10 per cent. lies above 2000 feet. The author has found that considerable and marked changes take place in the plant associations at about 2000 feet; tree vegetation ceases, and many alpine plants make their appearance which are absent from the lower moorlands.

The geological formation in the south and west of the district is chiefly Carboniferous limestone yielding only a small amount of detritus, whilst in the north and east the limestone thins out and is replaced to a great extent by sandstones, grits, and shales which yield a much larger amount of detritus. This feature has an important effect upon the vegetation, the wetter types of associations being developed upon those rocks yielding a large amount of detritus.

The moorlands first resolve themselves into two chief types, grass moorland and heather moorland, and these are frequently linked together by several intermediate plant associations. Dry heather moors or heaths do not cover any great extent of ground, and are chiefly found in the limestone districts of the south. The wetter types of heather moors are well developed, and the whole district can be briefly described as a wet heather and dry grass moorland country. These features are well shown in many of the "hopes" and gills leading out of Weardale and South Tynedale. The steep lower slopes of the hills are covered with an association having *Nardus stricta* as the dominant plant. Above 1500 feet to 1800 feet the slope of the ground becomes more gradual, and shales and grits make their appearance. At the same time the *Nardus stricta* association yields to heather associations in which Eriophorum is always a prominent plant. The succession of different types of moorland is often well shown along some of the "edges" in the north-east of the district. At Redbourne Edge the almost flat, poorly drained summit is entirely covered by Eriophorium bog, developed on deep wet peat. As the edge of the bog is approached the peat

FIG. 2.—Calluna and Vaccinium association on a dry wind-swept summit at 2326 feet. The lower vegetation developed on wet peat shows a great increase in Eriophorum. From the *Geographical Journal*.

[1] "Geographical Distributions of the Vegetation of the Basins of the Rivers Eden, Tees, Wear and Tyne." (*Geographical Journal*, March and September, 1904.)

becomes drier, and Eriophorum is replaced by a narrow band of Calluna moor. Peat is absent on the slope below, and the ground is tenanted by Nardus grass heath, yielding to a wetter type of grass heath dominated by Molinia and Eriophorum. Such a succession of terraces of Eriophorum bog, Calluna moor, Nardus grass heath, and Molinia-Eriophorum moor can be distinguished from a distance of many miles in the later months of the year, when the bleached Nardus stands out in vivid contrast to the sombre hued Calluna and Eriophorum associations.

The lower slopes of the alpine moorlands are generally covered by heather associations, which yield to pasture and grass heath as the summits are approached. The drier hills are covered by an association consisting of Calluna, *Rubus Chamaemorus*, *Vaccinium Myrtillus*, and *V. Vitis-Idaea*; the wetter hills are characterised by a much greater development of *Eriophorum vaginatum* and *E. angustifolium*.

The summits of the hills are generally tenanted by a few stunted members of the lower associations; in some cases, however, the vegetation only forms patches separated by bare stony soil or peat. Part of the summit plateau of Cross Fell at 2900 feet is entirely tenanted by *Racomitrium lanuginosum*, which forms low mounds of peat frequently broken by patches of stones and bare soil, a formation bearing a close resemblance to a moss-tundra of northern latitudes.

A considerable portion of the higher ground is covered with a deposit of peat varying in thickness from a few inches to nearly 20 feet. The peat appears to be undergoing rapid denudation at the present day—in many places large areas are quite unoccupied by vegetation, and exhibit the channelled and wasted appearance characteristic of peat-hags. These features can be seen on all the peat covered hills of the Pennines, the Cheviots, and the Scottish southern uplands, being particularly well marked on the Moorfoot Hills and in the Tweedsmuir district, and again appear in most of the peat districts of the Highlands. Many of the lowland mosses, particularly those bordering on the Solway Firth and along the west coast, exhibit no such denudation. How far the denudation of the mosses in the hill districts is due to drainage operations it is difficult to say, but the fact that the peat is generally wasted away quite as much on the more remote moorlands where artificial drainage has scarcely been carried on at all as on the drained areas lends strong support to the view that denudation is due to climatic changes. This is further supported by a detailed examination of the deeper peat beds, which frequently show many alternating beds of wet and dry condition plants. The peat beds on the Cross Fell chain are evidently of very ancient origin, as the author[1] has found the remains of an Arctic flora at the base consisting of Arctic willows, and the peat above contains the remains of extensive woodlands up to an altitude of 2700 feet. The area in which woodland remains in the peat have been observed is about 140 square miles, whilst only 11 square miles are forest clad at the present time.

Gunnar Andersson[2] has shown that the destruction of some of the woodlands buried in the peat of Sweden has been caused by artificial retention of drainage water and a gradual exhaustion of food supply in the upper layers of the peat, thus bringing about a gradual swing from woodland conditions to moss conditions, and again to heath conditions. These causes may have produced alternations of woodland, moss, and heath in some of our low-lying mosses, but an examination by the author of the peat lying between the woodland beds suggests that the destruction of much of the buried forest growth has been due, not to local alterations in drainage and failure of food supply, but to climatic changes acting over very long periods of time.

FRANCIS J. LEWIS.

THE ABNORMAL TIDES OF JANUARY 7.

AN abnormally high tide was experienced down the east coast of Britain on Saturday last, January 7, extensive areas being flooded and considerable destruction wrought. At 6 p.m. on Friday, January 6, as shown in the Meteorological Office reports, a very deep cyclonic system appeared over the upper part of the North Sea, the barometer at Sumburgh Head having fallen quickly to 28·7 inches. There was a steep gradient for north-westerly winds, and in the course of the night a more or less severe gale from that quarter was experienced over the North Sea, and as the south-going tide from the Pentland Firth was then on the flood, both its velocity and its volume were greatly increased, so that it reached the Thames estuary some hours ahead of its time, and was several feet above the calculated height. While the low barometer of Friday night may have caused the tide level in the far north to have been raised about a foot, the very rapid increase of pressure to 29·83 inches at 8 a.m. on Saturday at Sumburgh Head, a rise of 1·13 inches in fourteen hours, may have done something towards swelling the volume of the tide further south. Except for the hard gale, the conditions were very similar to those which prevailed with the great tide experienced on the southern and south-western coasts at the beginning of February, 1904 (NATURE, vol. lxix. p. 348).

Much damage was done all along the coast from Scarborough to the Thames. At the former place the pier was entirely washed away, and at Hull, Goole, Boston, Yarmouth and Lowestoft, and other places the low-lying parts of the towns were flooded. The damage was not due to unusual violence of the wind alone, but to the combined effects of wind and tidal waves. From the returns of the Meteorological Office it appears that the force of the gale from Wick to Yarmouth varied from 7 to 10 on the Beaufort scale. The tide was the third after the new moon, and laid down in the tide tables as less than a full spring tide. At Boston 28 feet 5 inches was recorded on the gauge at the dock, or 116·47 feet above Ordnance Datum, being 4 feet 8 inches above the height expected. The following tide in the evening was 21 feet 11 inches, or 1 foot 10 inches below the tide table height, the difference in the two tides being 6 feet 6 inches. The highest tide recorded there previously was in 1883, when the tide rose to 29 feet, the great record tide of 1810 rising to 29 feet 4 inches. Notwithstanding the great height to which the tide rose, it ceased flowing nearly half an hour before its proper time.

The tidal wave had fortunately somewhat expended its energy before reaching the Thames, but the water was in a very disturbed condition. By mid-day the water at Putney Bridge had risen as high as it should have been at full tide, which was not due until 3.45. At 1.30 it was a foot higher than any spring tide in recent years. Shortly after this the water began to recede, and continued to do so for half an hour. Then the water again rose, and at 3.15 the ebb again set in. The water in the Thames and Medway estuaries was kept from receding by the gale, and on the morning of Saturday it was 8 feet above its normal height. At 9 a.m., when the tide had still 4¾ hours to flow, it was running up the Medway 6 feet above the anticipated height at this stage. By 11 o'clock the level of high water was reached, but during the remaining 2¾ hours the flow was very slight compared with the earlier stages, and although the water rose from 2 to 3 feet above the normal height, there was no overflow or breaches in the banks.

THE ELECTRO-THERMIC MANUFACTURE OF IRON AND STEEL.[1]

THIS report is of great interest and importance to iron and steel metallurgists, and the appointment of the commission which has drawn it up suggests that Canada has an enterprise in fostering metallurgical knowledge which the Government of the mother country might well imitate for the advantage of British metallurgical industries. The English metallurgist attached to the commission was Mr. F. W. Harbord.

Three processes were experimentally examined:—(1) the Kjellin process at Gysinge, Sweden (this is an induction process not involving the use of electrodes); (2) the Héroult process at La Praz, France (this is a resistance method involving the use of electrodes); (3) the Keller process (also a resistance method in which electrodes are employed).

On p. 15 of the report Dr. Eugene Haanel, the chief

1 British Association Reports, 1904, Section K.
2 "Svenska Vaxtvarldens Historia." (Stockholm.)

1 "Report of the Commission appointed by Mr. Clifford Sifton, Minister of the Interior, Ottawa, Canada, to Investigate the Different Electro-thermic Processes for the Smelting of Iron Ores and the Making of Steel in Europe." (Ottawa: Department of Interior.)

commissioner, remarks that he considers "By far the most important experiments witnessed by the Commission were those made by Keller, Leleux and Company at their works at Livet."

It is a little difficult to realise upon what grounds the above conclusion was arrived at. Putting aside the speculative calculations of M. Keller and descending to experimental facts, it appears that the commission saw smelted several tons of pig-iron, as a rule remarkably high in manganese (1·5 per cent. to 4 per cent.), and hence of limited commercial interest, and as it is evidently not thought by the commission that the electric furnace is to become a serious competitor with the blast furnace, the specified exceptional value of these results from an industrial point of view is not quite clear.

As regards steel, only one not very satisfactory and untested heat was made (see pp. 77–78), yet upon such evidence the report states that this process is capable of producing steel equal to the best products of Sheffield's crucibles. Such premature conclusions based on such scanty data are not calculated to carry conviction to the experienced metallurgical mind.

The commission also describes a series of experiments made by M. Héroult at La Praz works. The analyses of the steels obtained appear quite satisfactory, but this process is hardly capable of competing with the ordinary open-hearth furnace even from the rosy point of view taken by the commissioners based on costs calculated (in all good faith) by the patentee.

From a British point of view Kjellin's induction process deserves the most serious attention in view of (under certain conditions) its probable competition with the crucible steel process.

Analytically, mechanically, and micrographically this steel leaves nothing to be desired, but unfortunately chemical and tensile tests, and the indications of the microscope, have a limited value in determining the working capabilities of tool-steel.

In his "conclusions" on p. 115 of the report, Mr. Harbord states that "Steel, equal in all respects to the best Sheffield crucible steel, can be produced, either by the Kjellin or Héroult or Keller processes, at a cost considerably less than the cost of producing a high-class crucible steel."

The above statement, so sweeping and involving issues of profound industrial import, should have been made only as the result of a series of exhaustive working tests. For such, in the report, the reviewer has sought in vain.

It is true that a series of tests of turning tools made from Kjellin and Héroult steels has been carried out at Woolwich by Mr. H. F. Donaldson, but the results are quite inconclusive, because of the steels employed hardly one was fit for turning tools.

Cold sett steel, carbon 0·8, cold chisel steel, carbon 0·9, tap-steel, carbon 1·1, and drill steel, carbon 1·2, have all been set to do the work of a comparative turning tool steel of carbon 1·38 per cent.

The natural consequence is that in the Woolwich results, where "E" means equal to the ordinary Woolwich turning tool steel of carbon 1·38, and "NE" means not equal to that steel, we find in the report, pp. 87 and 88, five "equals" and no less than fourteen "not equals."

As to whether Kjellin electric steel is or is not equal to crucible steel time alone can show. The conclusion of the commission may be accurate, but it is certainly not based on any scientific evidence worthy of the name.

Such evidence on a commercial scale can be conclusively obtained only by at least two comparative years of shop practice, employing all kinds of tools, and recording the average wear and waste of the steels as evidenced by the ratio between the work turned out and the annual cost of the tool steels purchased.

In the micrographic section of the report the reviewer notes with regret a recrudescence of the use (in this connection) of the meaningless and unscientific term "grain" in describing the allotrimorphic crystals of ferrite.

These crystals, although usually lacking idiomorphic external faces, nevertheless present that internal molecular symmetry associated with individual crystals, and hence should be classed as such.

Prolonged tests on Kjellin steel of all carbons, compared with similar crucible steels, have been inaugurated at the University College of Sheffield, and the erection of a Kjellin furnace capable of making one ton of steel per day is under consideration.

Without in any way compromising one's industrial attitude as to the exact capabilities of the respective methods devised by Messrs. Héroult, Keller and Kjellin, one can cordially congratulate these gentlemen on the scientific ability displayed in the development of their several methods, all of which, within their legitimate spheres, are undoubtedly of great metallurgical value. It is the more necessary to say this because such value is liable to be discounted by the hasty and ill-digested conclusions drawn by the Canadian commission.

J. O. ARNOLD.

LONDON FOG INQUIRY, 1901–3.[1]

THE Meteorological Council have issued their final report on the above inquiry, which had to be terminated at the end of the winter 1902–3 as the London County Council were unable to make any further contribution to its cost beyond the 250*l.* originally assigned. A short account of the chief results obtained by Captain Carpenter from the observations of the winter 1901–2 has already appeared in these columns (vol. lxvii. p. 548). During the succeeding winter records of the duration and intensity of fog were continued at forty-six stations in and around London, and in addition to this the scope of the inquiry was extended to include a detailed study of the distribution of air temperature over the London area. With this object thermometer screens and dry bulb thermometers were issued to thirty fire brigade stations, and daily observations of the air temperature were made at fixed hours.

The material so accumulated has been utilised to determine so far as possible the physical causes most active in producing fog in each case. The guiding principles adopted in the classification are those suggested in an article by the secretary to the Meteorological Council which appeared in NATURE (vol. lxiv. p. 649) at the time when the inquiry was started. The majority of our fogs were found to be due to radiation from the earth's surface during calm nights. Others, among them the most persistent fog of the winter, were caused by the passage of warm air over a previously cooled surface, while a third group were identified as "cloud" fogs. A certain number of fogs could not be included in any of the above categories. They appeared to be mere accumulations of the products of combustion in an almost calm atmosphere, and as such were termed "smoke" fogs. Full particulars of the thirty-nine most serious fogs of the winter are given in an appendix.

Among the chief results of the inquiry must be reckoned the establishment of a workable scale for the estimation of fog intensity by different observers, based on the extent to which traffic is impeded by land, river, and sea.

Comparison of the fog statistics from the various stations confirms Captain Carpenter's results. With a few possible exceptions which need further investigation, there is no evidence to show that, in London, geological formation has any influence on liability to fog. Again, as was to be expected, the fog frequency on the river and in the parks is very high, but the evidence does not support the view that the fog there found drifts far into the neighbouring districts.

With regard to the main purpose of the inquiry, greater precision in fog forecasts, Mr. Lempfert points out that a first step would be the establishment of a night service at the Meteorological Office. As the majority of fogs are caused by nocturnal radiation, and the intensity of this radiation depends largely on the accident whether the sky is free from cloud or not, it is manifest that forecasts issued at the suggested hour of 5 a.m. would have a much greater chance of proving correct than the present ones, which are based on observations taken at 6 p.m. on the previous evening. As most fogs become thick soon after sunrise, several hours' warning could still be given, though the hour would

[1] Report of the Meteorological Council upon an Inquiry into the Occurrence and Distribution of Fogs in the London Area, during the Winters of 1901–2 and 1902–3, with Reference to Forecasts of the Incidence and Duration of Fogs in Special Localities, to which is appended the Report by R. G. K. Lempfert, M.A. on the Observations of the Winter 1902–3.

be too late for the dissemination of the forecasts by the morning papers. Under the existing arrangements it was found that sixteen out of twenty-four "radiation" fogs and four out of eight "smoke" fogs were anticipated. The three "cold surface" fogs and four "cloud" fogs were not forecasted. The present forecasts rarely, if ever, contain any indications of the intensity of the fog expected.

The problem of the issue of fog warnings for individual districts has been approached from two points of view. As was pointed out in the previous report, the observations of drift smoke, during the incidence of fog usually show an indraught of air to some central district of London, but this is rarely symmetrical; a preponderating direction, usually identical with that due to the barometric gradient, can in most cases be identified, and plays a most important part in determining the region of thickest fog. Out of forty-four days of fog twenty-seven showed the thickest fog to leeward, five showed it to windward, while in the remaining twelve cases no particular preference for any one locality could be identified. Captain Carpenter had suggested that a more detailed study of the distribution of temperature might prove useful in this connection, and Mr. Lempfert reproduces diagrams which show conspicuous differences of temperature within the London area, in which the thickest fog is also to be found in the coldest region. Four out of the five apparently exceptional cases in which fog was thickest to windward show the lowest temperatures also on the windward side. It is the more to be regretted that the inquiry has had to be discontinued as the winter proved to be singularly free from fog. Investigation of the thick fogs of the present season from this point of view would probably have yielded interesting results.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

EDINBURGH.—The annual report for 1904 shows that the total annual value of the university fellowships, scholarships, bursaries, and prizes now amounts to about 18,270*l.* In addition, a sum of upwards of 600*l.*, being the income of the Earl of Moray endowment fund, is annually available for the encouragement of original research. As already announced, in response to the appeal for subscriptions to provide for the further development of the university, Sir Donald Currie has made the munificent gift of 25,000*l.* He has expressed a wish that the revenue from his money should be applied to the remuneration of a staff of lecturers such as the authorities of the university may find it advisable from time to time to appoint. The university court, being desirous of permanently associating his name with the fund, has resolved to designate it "The Sir Donald Currie Lectureship Endowment Fund." Other contributions to the extension scheme have also been intimated to the extent of 15,000*l.*, including a sum of 5000*l.* given by Sir John Jackson to the Tait memorial fund, for the encouragement of physical research.

LIVERPOOL.—The committee of the institute of archæology has been enabled by the munificence of Sir John Brunner to take in hand the publication of a "History of Egypt," to include all the results of modern research, and to be, so far as possible, a complete history of the Egyptian civilisation from the earliest times down to the conquest by Alexander the Great. It is estimated that the work will take two years to complete, and it will be published with full photographic illustrations.

A CONFERENCE on school hygiene has been arranged by the Royal Sanitary Institute, to be held in the University of London, under the presidentship of Sir Arthur W. Rücker, F.R.S., on February 7–10.

A COURSE of ten lectures on "Enzymes" will be given by Dr. W. M. Bayliss, F.R.S., at University College, London, commencing on January 18. The lectures are open to all internal students of the university, and also to medical men on presentation of their cards.

THE sixteenth issue of the "Public School Year Book"—that for 1905—with its select list of preparatory schools, is as useful as ever. The information given respecting each public school connected with the Headmasters' Conference is of just the kind to help parents to a decision as to where to send their boys to be educated.

PROF. FRITZ HEISE, of the Berlin School of Mines, has been appointed director of the Bochum School of Mines, and Mr. Georg Baum, the author of several works on coal-mining, has been appointed to succeed him in the Berlin chair. Mr. August Schweman, mine manager of Neurode, has been appointed professor of mining at the Aachen Technical High School to fill the vacancy caused by the death of Mr. Lengemann.

IN view of the educational and scientific progress which Japan has made in recent years, the two lectures on "The Japanese Spirit," which will be delivered by Mr. Y. Okakura, of the Imperial University, Tokyo, at the London School of Economics, Clare Market, W.C., on January 17 and January 20, should be of special interest. Tickets of admission may be obtained free from the secretary of the school.

Science reports that Mr. W. A. Riebling, of Newark, N.J., has sent an additional 2000*l.* to the Rensselaer Polytechnic Institute, Troy, N.Y., to be used in replacing the building destroyed by fire. Mr. Riebling gave 2000*l.* last June. A gift of 1000*l.* from Mr. George B. Cluett is also announced. Wellesley College has received 3600*l.*, we also learn, from the Robert Charles Billings fund, the income of which is to be applied to the department of botany.

THE West Riding Education Committee has resolved, says the *British Medical Journal*, subject to certain conditions, to make grants, which will doubtless be renewed annually, to the Universities of Leeds and Sheffield of 4500*l.* and 1500*l.* respectively. In thanking the county council for the grant to Leeds, the Pro-Chancellor, Mr. A. G. Lupton, stated that of the 100,000*l.* for which the university was now asking a sum of 64,000*l.* had already been subscribed.

THE 1905 edition of the "Schoolmaster's Yearbook and Directory" follows on the same excellent lines as the issue of last year. It contains an immense amount of well arranged information, and has become indispensable to all engaged in educational work. If the publication continues to increase in size, as it seems to do annually, the section on the books of the year might be dispensed with, as information of the same kind can be obtained from many educational periodicals. The editor is to be congratulated on the fact that this useful work of reference has become established so securely.

A RESEARCH scholarship or scholarships, founded by Mr. Andrew Carnegie, will be awarded shortly on the recommendation of the council of the Iron and Steel Institute. Candidates, who must be under thirty-five years of age, must apply on a special form before the end of February to the secretary of the institute. The object of this scheme of scholarships is not to facilitate ordinary collegiate studies, but to enable students, who have passed through a college curriculum or have been trained in industrial establishments, to conduct researches in the metallurgy of iron and steel and allied subjects, with the view of aiding its advance or its application to industry. There is no restriction as to the place of research which may be selected, whether university, technical school, or works, provided it be properly equipped for the prosecution of metallurgical investigations.

A CONFERENCE of teachers from elementary and secondary schools and technical institutes was held under the auspices of the London County Council at the Medical Examination Hall, Victoria Embankment, on January 5, 6, and 7. On the first of these days, under the presidency of Sir William Collins, the teaching of arithmetic was discussed. Mr. C. T. Millis, principal of the Borough Polytechnic, said that what is needed in the teaching of arithmetic is that some of the time now spent in teaching special rules in money sums should be devoted to giving a sound knowledge of general principles. Mr. S. O. Andrew, during the course of a paper on the same subject, remarked that whatever part of arithmetic may be given up or postponed, there is a general agreement that it must still include a know-

ledge of the standards of measurement necessary for the investigation of physical phenomena. The need for a co-ordination of the elementary instruction in arithmetic and geometry was emphasised by subsequent speakers.

THE third annual meeting of the North of England Education Conference was held in Liverpool on January 6 and 7. More than 2000 members of education committees, teachers, and others attended. The question of leaving certificates was discussed at the first meeting, and during the course of the discussion Sir Oliver Lodge said the use and not the abuse of examinations is admitted by all as an adjunct to teaching, but the point is to determine the relation between teachers and examiners, also between teachers and inspectors. People are no longer going to be satisfied with purely external examinations imposed from above upon the schools. It is not a dignified position for the schools, and they have rebelled. Prof. Sherrington, F.R.S., read a paper later on child study, in which he urged that this study could not devote itself more profitably at the present time than to what may be termed the natural history of the child. In healthy school life lay the first line of defence against race deterioration. It would help society if teachers and physiologists could combine to examine into the mischief to growth resulting from hours of breathing vitiated air, from want of warm clothing that economised food, from semi-starvation, from improper food, from chronic fatigue, and from insufficient rest and sleep in bed. Among other subjects dealt with were the teaching of geography, the teaching of domestic science, and the place of handwork in the school curriculum.

A DEPUTATION from the executive committee of the Association of Education Committees (England and Wales) recently waited upon the Board of Education to urge the adoption of a more liberal scale of grants for secondary schools, to ask for a larger share from the Government of the cost of training pupil teachers, and to urge the necessity for the compulsory attendance up to the age of fourteen at evening continuation schools of all children who do not continue as whole-day scholars up to that age. Sir William Anson, in reply to the deputation, agreed that more money should be allowed to secondary schools, but though such a demand would have his support, Sir William Anson said he was by no means sure of obtaining the necessary funds. He expressed the opinion that the question of cost made it almost impossible to enforce a system of compulsory attendance at evening continuation schools up to fourteen years of age for children leaving the day school before that time. Until we have better security that the education given in the elementary school lasted, and a better secondary education system with larger grants for secondary schools, Sir William added, he would not be a party to asking for another penny for elementary education, as such. It is satisfactory to find it recognised officially that this country must spend more money on secondary and technical education if we are to have an educational system which will assist national progress.

THE annual meeting of the Geographical Association was held on January 6. Mr. Douglas Freshfield presided, and an interesting discussion took place on the teaching of practical geography in schools. Prof. Dryer, of the State Normal College, Terre Haute, Indiana, opened the debate, and said that practical geography meant in America laboratory work. This work is not necessarily done in a special room, and, indeed, the best part of it is done out of doors. The study of maps plays a large part in this laboratory work. Contoured topographical maps are also much used, together with raised models illustrating different forms of the earth's surface. Pictures, photographs, and lantern slides also have a conspicuous place in the school's equipment. The instrumental study of the earth's atmosphere is taken next by the students, who keep records of their own observations for a period of three months. The official weather charts can be obtained daily at every school, and, owing to the area covered by them, it is possible to follow cyclonic and anti-cyclonic disturbances for several days together, and sometimes to predict in the school itself the arrival at a particular time of an atmospheric disturbance. Field excursions are regarded as the most important part of geographical study. Mr. B. B. Dickinson described an experiment in the teaching of practical geography carried out by him at Rugby School. The report of the association shows that 123 new members have been added to the roll, making the total membership 448. The members now include teachers of every grade, school inspectors, directors of education, technical education committees, and others interested in geographical education, both at home and abroad.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 1, 1904.—"The Ascent of Water in Trees." By Dr. Alfred J. **Ewart**, Lecturer on Botany in the University of Birmingham.

Since the time when Strasburger's researches seemed to show that the ascent of water in trees was a purely physical phenomenon, attempts have been made by Dixon and Joly, as well as by Askenasy, to prove that the ascent of water is due to a tensile stress set up by transpiration in the leaves, and transmitted downwards by continuous water-columns which are practically suspended from them. A knowledge of the resistance to the transpiration current in the stems of trees, and of the influence of various factors upon it, forms, however, an essential preliminary to any such explanation.

The author finds that when the vessels are completely filled with water and are open at both ends, the flow through them takes place in accordance with Poisseuille's formula, the rate of flow being directly proportional to the pressure and inversely proportional to the viscosity of the liquid and the square of the radius of the vessel. Hence in climbing plants where a rapid rate of flow is required the vessels are large, approaching 1 mm. in diameter, and in such cases the total viscosity resistance during average transpiration is equal to a head of water considerably less than the height of the stem. Under normal conditions, however, air bubbles always appear in the conducting vessels of angiospermous trees, and each bubble exerts a resistance to flow which is directly proportional to the surface tension of water against air and inversely proportional to the radius of the tube. In a tall tree the theoretical resistance due to this cause alone might amount to as much as 300 atmospheres, whereas calculations from direct experiments gave total resistances for the tallest trees of 100 atmospheres during active transpiration.

No leaf could produce or maintain an osmotic suction of this intensity, nor could the water columns in the vessels transmit it without rupture. In addition, actual observation showed that although differences do occur in the osmotic concentration of the cell-sap in the leaves at different levels, these are not sufficient to overcome the resistance to average flow in the intervening portions of the trunk. It appears, therefore, that a staircase pumping action must be exercised in the wood of a tall tree, which enables the leaves to obtain the water they require without their being forced to exercise tensions of more than $\frac{1}{2}$ to $\frac{2}{3}$ of an atmosphere. No satisfactory physical explanation of such action has yet been given, but the author points out that by appropriate surface-tension action along the length of a Jamin's chain the water could be led upwards from water-column to water-column, and maintained in a labile condition ready to flow in any direction where moderate suction was exercised. Various indirect estimations have been made which lend support to this view, but direct observations have not hitherto yielded satisfactory proof, so that further investigations are still needed in this direction, and these are, in fact, in progress.

December 15, 1904.—"An Analysis of the Results from the Falmouth Magnetographs on 'Quiet' Days during the Twelve Years 1891 to 1902." By Dr. Charles **Chree**, F.R.S.

The paper contains an analysis and discussion of the results obtained from the declination and horizontal force magnetographs at Falmouth on quiet days from 1891, when the records commenced, until 1902.

The total secular changes of declination from 1891 to 1900 at Kew and Falmouth were identical, and the changes

from year to year were closely alike. In horizontal force the annual changes recorded at the two stations did not agree so closely, and on the average the change at Falmouth was somewhat the greater.

Whilst the mean daily range of temperature at Falmouth —a seaside station—is notably less than at Kew, the daily ranges of declination at the two places are as nearly as possible equal, and the daily range of horizontal force is somewhat larger at Falmouth.

The annual variation of diurnal temperature range is again notably less at Falmouth than at Kew, the winter range at the former station being relatively high, and the summer range low. There is in this case a somewhat analogous state of matters in magnetics, the difference between the diurnal ranges at midsummer and midwinter being relatively less at Falmouth than at Kew.

Analysing the diurnal inequality of temperature into harmonic terms, General Strachey (*Phil. Trans.* for 1893) found that the local time of occurrence of the maxima was distinctly earlier at Kew than at Falmouth, the difference being greatest for the 24-hour term, for which it amounted to nearly an hour. When the declination and horizontal force diurnal inequalities are similarly analysed, the local times of occurrence of the maxima are so nearly alike at the two stations that it is impossible to say with certainty which is the earlier. This result applies to the average year of a sun-spot cycle.

When the annual variations in the amplitudes of the daily ranges in declination and horizontal force at Kew, and of the 24, 12 and 8-hour terms in the diurnal inequality, were expressed as Fourier series, with an annual and a semi-annual term, there proved to be a remarkably close agreement between the dates of occurrence of maximum in the annual terms, and also in those of the semi-annual terms for the several elements. The same phenomenon appears at Falmouth, and there proves, moreover, to be a remarkably close agreement between corresponding Kew and Falmouth dates. This result again applies to the average year of a sun-spot cycle.

Applying Wolf's formula $R = a + bS$, associating the range R of a magnetic element with sun-spot frequency S, results are obtained for the variation of b and b/a throughout the year at Falmouth very similar in character to those previously obtained for Kew.

Taking the above formula, but making S represent in turn the areas of whole sun-spots, umbræ and faculæ as given by the Astronomer Royal, values are calculated for a and b in the case when R represents the range of declination or horizontal force in the mean diurnal inequality for the year. A comparison is then instituted between the ranges for individual years of the 12-year period as calculated from the values of a and b thus found, and the Astronomer Royal's mean yearly data on the one hand, and as actually observed on the other. When S represents areas of whole sun-spots or of umbræ, the agreement between observed and calculated ranges is nearly though not quite so good, especially in horizontal force, as when S represents Wolfer's sun-spot frequencies; but when S represents areas of faculæ the agreement is much inferior, especially in years of sun-spot maximum.

"The Effect of Temperature on the Thermal Conductivities of some Electrical Insulators." By Dr. Charles H. **Lees.**

The substance the thermal conductivity of which is to be determined has the form of a cylinder about 8 cm. long, 2 cm. diameter, surrounded by a thin cylinder of brass and placed in a Dewar tube. The heat is supplied by the passage of an electrical current through a platinoid wire embedded in the substance parallel to the axis of the cylinder, and about 0·4 cm. distant from it. The temperature is measured by the electrical resistance of two short spirals of No. 40 pure platinum wire, down the centre of one of which the heating wire passes.

The difference of temperature of the two spirals is determined by making them two arms of a resistance bridge, the other two arms of which are equal. By means of mercury cups resistances may be placed in series with either of the spirals until a balance is obtained.

A few values of the conductivities in C.G.S. units for a portion of the range of temperature on the hydrogen scale are given in the following table:—

	At 120° abs.	At 180° abs.	At 240° abs.
Ice	0·0062	0·0058	0·0052
Naphthaline	0·0013	0·0011	0·00091
Aniline	0·0011	0·00086	0·00070
Nitrophenol (para) ...	0·0010	0·00085	0·00070
Glycerine	0·00078	0·00082	0·00076
Paraffin wax	0·00060	0·00065	0·00061
β-Naphthol	0·00067	0·00065	0·00063
Diphenylamine	0·00058	0·00054	0·00052

Geological Society, December 21, 1904.—Dr. J. E. Marr, F.R.S., president, in the chair.—On certain genera and species of Lytoceratidæ: S. S. **Buckman.** This paper deals with certain specimens sent by Mr. Beeby Thompson from the Northampton Sands, one of which is remarkable for its homœomorphy with Phylloceras.—The Leicester earthquakes of August 4, 1893, and June 21, 1904: Dr. C. **Davison.** The earthquake of 1893 was a twin, with its principal epicentre between Markfield and Woodhouse Eaves, and the other near Tugby, about seventeen miles to E. 34° S. Its disturbed area contains about 2200 square miles. On June 21, 1904, two shocks were felt: the first, a very slight one, at about 3.30 a.m., the second at 5.28 a.m. The epicentre of the earlier shock was in the neighbourhood of Markfield and Groby, or near the south-eastern margin of the north-western focus of 1893. The distance between the epicentres of the earthquakes of 1904 was about twelve miles. Thus the foci of 1904 appear to have occupied the nearer margins of the foci of 1893.—The Derby earthquakes of July 3, 1904: Dr. C. **Davison.** Although weaker than the earthquake of March 24, 1903, this shock, owing to its occurrence at 3.21 on a Sunday afternoon, was felt over a much wider area (about 25,000 square miles). As in 1903, the earthquake was a twin, the epicentres being almost exactly coincident with those of that year, one being situated near Ashbourne, and the other, about six or seven miles from it, near Wirksworth and Matlock Bath.—Twin-earthquakes: Dr. C. **Davison.** In a twin-earthquake, the shock consists of two maxima of intensity, or of two distinct parts separated by a brief interval of rest and quiet. In Great Britain, one in every twenty earthquakes is a twin, and our strongest shocks (the Colchester earthquake of 1884, the Hereford earthquake of 1896, &c.) belong to the same class. The phenomena show that twin-earthquakes cannot be caused by reflection or refraction of the earth-waves, or by the separation of the waves of direct and transverse vibrations, or by the repetition of the impulse within the same or an overlapping focus. They must therefore be due to impulses in two detached, or practically detached, foci; and it is shown that all the known phenomena of twin-earthquakes can be thus accounted for. In British twin-earthquakes, the distance between the epicentres varies from four to twenty-three miles, the average for seven recent earthquakes being between ten and eleven miles. As a rule, the foci are elongated approximately in the direction of the line joining them, showing that they are portions of the same fault. The foci appear to be situated at different depths, and, in two cases, the fault probably changes hade in the region between them.

Royal Microscopical Society, December 21, 1904.—Mr. G. C. Karop in the chair.—Mr. **Conrady** read a short paper explaining an experiment he exhibited to prove the phase-reversal in the second spectrum from a grating of broad slits, the mathematical proof of which he gave in his paper on theories of microscopical vision read before the society at its last meeting. The object consisted of two gratings one above the other, similar in every respect except that one had broad slits and the other had narrow slits. In accordance with what was theoretically predicted by the author, the difference was brought out when the direct light plus the first and second spectra of *one side* were admitted, but when the direct light was cut off by the movement of a shutter the image of the *broad slits* underwent a startling change. The lines jumped across to positions mid-way between the correct ones, showing there was an antagonism of phase between the light of the first and that of the second spectrum. Some photographs showing the effects produced by cutting out the various spectra

of one side were exhibited by Mr. Rheinberg, who suggested to Mr. Conrady that the experiment should be made to test the correctness of the theory.—Mr. J. W. **Gordon** then gave a summary of his paper on the theory of highly magnified images.

EDINBURGH.

Royal Society, December 5, 1904.—Dr. R. H. Traquair in the chair.—The igneous geology of the Bathgate and Linlithgow Hills: J. D. **Falconer.** Five successive zones of igneous rocks were described in detail, and important conclusions drawn as to their geological age and to the relations between the intrusive rocks and dykes so characteristic of the region. The region has been very recently re-surveyed by the Geological Survey, and Dr. Horne, Dr. Peach, and others of the staff were able to corroborate many of Mr. Falconer's results, the value of which could not be over-estimated. A further paper was promised dealing with the petrology of the district.—Experiments on the simultaneous removal of spleen and thymus: Drs. Noel **Paton** and **Goodall.** Already the authors had found that the removal of either had no apparent deleterious effect upon the life of the animal, and now they proved that the removal of both in no way affected the vitality. The experiments were made on guinea-pigs.—Crystallographical notes: Dr. Hugh **Marshall,** F.R.S. The author suggested (1) that the "axis of compound symmetry of second order" should not be used in crystallographical work, as it is not a definite direction in the crystal, and that the "centre of symmetry" should be used instead; (2) that in order to simplify the classification of crystals for teaching purposes, the rhombohedral and scalenohedral classes should be treated as members of the hexagonal and not of the trigonal system.

December 19, 1904.—Sir John Murray in the chair.—A supplementary note on the Lower Devonian fishes of Gemunden: Dr. **Traquair.** The author brought forward further evidence in support of his original description, which had been criticised by Prof. Bashford Dean.—A specimen of salmon caught in the Galway River which appears to be intermediate between the smolt and grilse stages: W. L. **Calderwood.**—Networks of the plane in absolute geometry: D. M. Y. **Sommerville.** Networks built up of the various regular figures in the Euclidean plane were discussed at considerable length, and the investigation was then extended to non-Euclidean planes.

PARIS.

Academy of Sciences, January 2.—M. Troost in the chair.—The cooling power of a current of fluid on an ellipsoid with unequal axes immersed in the current: J. **Boussinesq.**—Interference fringes produced by a system of two perpendicular mirrors: G. **Lippmann.** The system of fringes formed, possessing a white central fringe, is parallel to the intersection of the plane of the mirrors. The experimental arrangement for the production of these fringes, which is described in detail, is simpler than that required for the Fresnel fringes.—On the alkaline microgranites of the Zinder territory: A. **Lacroix.** The rocks are ægyrine and amphibole microgranites, and are characterised chemically by their extreme poorness in lime and magnesia, and by the quantity of alkali, the potash being slightly in excess of the soda.—On limiting functions and functional operations: Maurice **Fréchet.**—On substitutions with three variables and invariant curves by a contact transformation: S. **Lattès.**—On invariant subgroups of index p^2: G. **Miller.**—On the deviation of freely falling bodies: M. **de Sparre.** It is shown that the formulæ usually given for this deviation are based on incomplete data, and a new expression is deduced. It is, however, impossible to check the calculations by experiment, on account of the smallness of the deviations, which would amount at most to 0·1 mm. for a fall of 1000 metres.—On a fundamental formula in the kinetic theory of gases: P. **Langevin.** The formulæ given by Maxwell and Boltzmann for the diffusion of gases is re-investigated, and the results applied to the diffusion of ionised gases. The author arrives at the conclusion that the conductivity of flames is, for the most part, due to the presence of free kathodic particles arising from spontaneous corpuscular dissociation in the flame, under the action of the high temperature.—The measurement of the conductivity of dielectrics by means of ionised gases: Charles **Nordmann.** One of the faces of the dielectric, the other of which is connected with earth, is supplied with known quantities of electricity per unit of time, and the variation of the potential of this face is observed with an electrometer. The constant charge is produced by means of a radio-active substance placed between the plates of an air condenser, and the stationary potential is measured. Details of the measurements will be communicated in a later paper.—The influence of steam on the reduction of the oxides of iron by carbon monoxide and dioxide: O. **Boudouard.** With the view of throwing some light on the results of employing dried air in the blast furnace, the author has made experiments on the influence of moisture on the reducing action of carbon monoxide, either pure or mixed with the dioxide, upon ferric oxide. It has been found that the dry gases exert a more energetic reducing action than the moist gases, but that this difference, which is considerable at low temperatures, becomes negligible at high temperatures.—On the existence of a normal green chromic sulphate: Albert **Colson.**—The separation of the three dimethylanthracenes obtained by the action of methylene chloride upon toluene in the presence of aluminium chloride: James **Lavaux.** Modifications of the Friedel and Crafts method are described, by means of which larger and more constant yields are obtained. These modifications appear to be not only advantageous in this particular case, but are applicable to any reaction carried out in the presence of aluminium chloride.—Observations of the Giacobini comet (*d* 1904) made at the Observatory of Algiers with the 31·8 cm. equatorial: MM. **Rambaud** and **Sy.**—On the crystalline rocks collected by the Sahara expedition: F. **Foureau** and L. **Gentil.**—The resistance of water to the motion of vessels. Hulls of least resistance: Vice-Admiral **Fournier.**—Hydrogen peroxide in the nascent state and its bactericidal activity on organisms in water: Ed. **Bonjean.** It is shown that whilst 0·291 gram of hydrogen peroxide per litre was required to sterilise a litre of Seine water in six hours when commercial hydrogen peroxide was employed, under the same conditions, 0·060 gram was sufficient to produce sterilisation in four hours when the hydrogen peroxide was in the nascent state from calcium peroxide.—Hyphoids and bacteroids: Paul **Vuillemin.** Hyphoids and bacteroids are not purely parasitic formations, but are symbiotic products.—Research on plant radio-activity: Paul **Becquerel.** No trace of radio-activity of plant products could be observed if precautions were taken to prevent the moisture transpired by the plant from reaching the electrometer. The author therefore regards the positive results announced by M. Tommasina as being due to a neglect of this precaution.—On the accentuation of the alpine characters of leaves in juniper galls: C. **Houard.**—On the increase of weight of organic and mineral substances in oats as a function of the age: Mlle. M. **Stefanowska.**—Respiratory measurements on marine fishes: J. P. **Bounhiol.** By means of a specially devised tank the author has been enabled to determine the carbon dioxide per gram-hour, the oxygen per gram-hour, and the ratio CO_2/O_2 for several fishes. The effect of captivity in diminishing the respiratory exchanges was well marked.

NEW SOUTH WALES.

Linnean Society, November 30, 1904.—Dr. T. Storie Dixson, president, in the chair.—Contributions to the study of Australian Foraminifera, part i.: H. I. **Jensen.** This paper, for the most part, is a compilation of the species which have been identified in samples of sand or other materials obtained from various sources.—Revision of Australian Lepidoptera, part ii.: Dr. A. Jefferis **Turner.** Some supplementary remarks on the family Notodontidæ (revised in a previous paper) are offered, and the family Syntomidæ, comprising four genera with forty-four species (of which eight are described as new), is reviewed.—A yellow race of *Bacillus pseudarabinus* from the quince: Dr. R. Greig **Smith.** The organism is identical in its morphological and cultural characters with the white race previously isolated from the sugar-cane. The gum obtained from the slime was also identical in giving the reactions of arabin and in yielding only galactose upon hydrolysis. While the cultivations of the sugar-cane race were always white, those

of the quince race were yellow.—The bacterial origin of Macrozamia gum: Dr. R. Greig **Smith.** An organism, *Bacillus macrozamiae*, n.sp., isolated from the tissues of *Macrozamia spiralis* which was exuding a gum, produced, upon lævulose media, a slime from which a gum was obtained.—On a new species of Rhizophyllum from the Upper Silurian rocks of Yass, New South Wales: A. J. **Shearsby.** A third species of Calceola-like, operculate, rugose corals is described.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 12.

MATHEMATICAL SOCIETY, at 5.30.—Generational Relations for the Abstract Group simply Isomorphic with the Abstract Group LF [2, p^n]; Dr. W. Bussey.—On a Class of Expansions in Oscillating Functions: Prof. A. C. Dixon.—Isogonal Transformation and the Diameter Transformation: H. L. Trachtenberg.—A Generalisation of the Legendre Polynomial: H. Bateman.—Current Flow in Rectangular Conductors: H. Fletcher Moulton.—Basic Generalisations of some well known Analytic Functions: Rev. F. H. Jackson.—On the Kinematics and Dynamics of a Granular Medium in Normal Piling: J. H. Jeans.—On Alternants and Continuous Groups: Dr. H. F. Baker.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Combination of Dust Destructors and Electricity Works Economically Considered: W. P. Adams. (Conclusion of Discussion.)—Fuel Economy in Steam Power Plants: Wm. H. Booth and J. B. C. Kershaw.

FRIDAY, JANUARY 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.—On the Temperature of Sun-spots and on the Spectrum of an Artificial One: W. E. Wilson.—On Terms of Long Period in the Complete Expression for the Moon's Longitude: E. Nevill.—The Longitude of the Moon's Perigee: P. H. Cowell.—On the Relative Brightness of Stars: J. E. Gore.—On the Variable Star Y Aurigæ: A. S. Williams.—The Spiral Nebula M I. 153 Ceti: W. S. Franks.—Sun-spots and Magnetic Storms: A. Schuster.—*Promised Papers*: Magnetic Storms and Associated Sun-spots: Rev. A. L. Cortie.—On the Possible Effect of Radiation on the Motion of Comets: H. C. Plummer.—Note on the Re-determination of the Paris-Greenwich Longitude (communicated by the Astronomer-Royal).—Observations of the Spectra of Sun-spots, Region C to D (communicated by the Astronomer-Royal).—*Probable Discussion* of Mr. Maunder's Paper in the *Monthly Notices*, on the Connection of Magnetic Storms with the Rotation of the Sun.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Theory of Electricity and Magnetism: James Swinburne.

MALACOLOGICAL SOCIETY, at 8.—A Review of the Genera of the family Mytilidæ: A. J. Jukes-Browne.—Note on the Type of Geomelania, with Description of New Species: E. R. Sykes.—On Three Species of Dyakia from Sumatra: E. R. Sykes.—Some Nudibranchs from the Pacific, including a New Genus, Chromodoridella: Sir C. Eliot, K.C.M.G.—Notes on Two Rare British Nudibranchs, *Hero formosa*, var. *arborescens*, and *Staurodoris maculata*: Sir C. Eliot, K.C.M.G.—Description of a new Achatina from the Zambesi: H. B. Preston.

MONDAY, JANUARY 16.

VICTORIA INSTITUTE, at 4.30.—The History of Rajputana: Col. T. Holbein Hendley.

TUESDAY, JANUARY 17.

ROYAL INSTITUTION, at 5.—The Structure of Animals: Prof. L. C. Miall, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The River Hooghly: L. F. Vernon-Harcourt.

ZOOLOGICAL SOCIETY, at 8.30.—On a Collection of Sipunculids made at Singapore and Malacca: W. F. Lanchester.—On a Collection of Gephyrea from Zanzibar: W. F. Lanchester.—On the Sipunculids and Echiurids collected during the "Skeat Expedition" to the Malay Peninsula: W. F. Lanchester.—On the Oral and Pharyngeal Denticles of Elasmobranchs: A. D. Imms.—A Contribution to the Anatomy of Chlamydosaurus and some other Agamidæ: F. E. Beddard, F.R.S.—A Note on the Brain of *Cynopithecus niger*: F. E. Beddard, F.R.S.

WEDNESDAY, JANUARY 18.

CHEMICAL SOCIETY, at 5.30.—(1) Nitrogen Halogen Derivatives of the Sulphonamides. Part i.: Sulphondichloroamides and Sulphonalkylchloroamides.—(2) Nitrogen Halogen Derivatives of the Sulphonamides. Part ii.: Sulphondibromoamides and Sulphonalkylbromoamides: F. D. Chattaway.—Electrolytic Oxidation of Aliphatic Aldehydes: H. D. Law.—The Diazo-derivatives of the Benzenesulphonylphenylenediamines: G. T. Morgan and F. M. G. Micklethwait.—The Molecular Condition in Solution of Ferrous Potassium Oxalate: S. E. Sheppard and C. E. K. Mees.—The Formation of Magnesia from Magnesium Carbonate by Heat, and the Effect of Temperature on the Properties of the Product: W. C. Anderson.—Transformations of Derivatives of *s*-Tribromodiazobenzene: K. J. P. Orton.—The Addition of Sodium Bisulphite to Ketonic Compounds: A. W. Stewart.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting. Address by the President, Prof. E. B. Poulton, F.R.S.

GEOLOGICAL SOCIETY, at 8.—The Geology of Arenig Fawr and Moel Llyfnant: W. G. Fearnsides.

SOCIETY OF ARTS, at 8.—Wireless Telegraphy and War Correspondence: Capt. Lionel James.

ROYAL MICROSCOPICAL SOCIETY, at 8.—What were the Carboniferous Ferns? the President's Annual Address.

ROYAL METEOROLOGICAL SOCIETY, at 7.40.—Annual General Meeting. Address on the Connection of Meteorology with other Sciences: the President, Capt. D. Wilson-Barker.

THURSDAY, JANUARY 19.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the "Blaze Currents" of the Gall Bladder of the Frog: Mrs. A. M. Waller.—The Dual Force of the Dividing Cell. Part i.: The Achromatic Spindle Figure illustrated by Magnetic Chains of Force: Prof. M. Hartog.—Note on the Effects produced on Rats by the Trypanosomata of Gambia Fever and Sleeping Sickness: H. G. Plimmer.—Further Histological Studies on the Localisation of Cerebral Function. The Brains of Felis, Canis and Sus compared with that of Homo: Dr. A. W. Campbell.

LINNEAN SOCIETY, at 8.—Botanical Collecting: Dr. A. Henry.—On the Cranial Osteology of the Families Osteoglossidæ, Pantodontidæ, and Phractolæmidæ: Dr. W. G. Ridewood.

SOCIETY OF ARTS, at 4.30.—The Gates of Tibet: Douglas W. Freshfield.

FRIDAY, JANUARY 20.

ROYAL INSTITUTION, at 9.—New Low Temperature Phenomena: Sir J. Dewar, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Some Impressions of American Workshops: A. J. Gimson.—Waterworks Pumping Engines in the United States and Canada: J. Barr.—Some Features in the Design and Construction of American Planing Machines: A. Kenrick, Jun.: Engines at the Power Stations, and at the St. Louis Exhibition: A. Saxon.

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